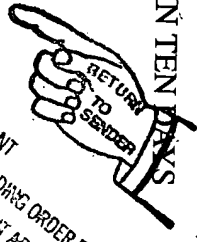BEST AVAILABLE COPY

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# UNITED STATES PATENT AND TRADEMARK OFFICE

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 10/642,789 | 08/19/2003 | Andrew. John Cardno | | 3718 |

| | | |
|---|---|---|
| 37942 | 7590 | 03/16/2006 |

COMPUDIGM SERVICES INC.
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| EXAMINER |
|---|
| CHOW, JEFFREY J |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2672 | |

DATE MAILED: 03/16/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

| | Application No. | Applicant(s) |
| **Office Action Summary** | 10/642,789 | CARDNO, ANDREW. JOHN |
| | Examiner | Art Unit | |
| | Jeffrey J. Chow | 2672 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on <u>19 August 2003</u>.

2a)☐ This action is **FINAL**.    2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) <u>1-24</u> is/are pending in the application.

   4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) <u>1-24</u> is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

   Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

   Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   a)☐ All  b)☐ Some * c)☐ None of:

     1.☐ Certified copies of the priority documents have been received.

     2.☐ Certified copies of the priority documents have been received in Application No. _____.

     3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

   * See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1)☒ Notice of References Cited (PTO-892)

2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3)☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4)☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5)☐ Notice of Informal Patent Application (PTO-152)

6)☐ Other: _____.

## DETAILED ACTION

### *Specification*

The abstract of the disclosure does not commence on a separate sheet in accordance with

37 CFR 1.52(b)(4).  A new abstract of the disclosure is required and must be presented on a

separate sheet, apart from any other text.

### Content of Specification

(g)    Brief Summary of the Invention: See MPEP § 608.01(d).  A brief summary or
general statement of the invention as set forth in 37 CFR 1.73.  The summary is
separate and distinct from the abstract and is directed toward the invention rather
than the disclosure as a whole.  The summary may point out the advantages of the
invention or how it solves problems previously existent in the prior art (and
preferably indicated in the Background of the Invention).  In chemical cases it
should point out in general terms the utility of the invention.  If possible, the
nature and gist of the invention or the inventive concept should be set forth.
Objects of the invention should be treated briefly and only to the extent that they
contribute to an understanding of the invention.

The summary of the invention is objected because the summary is essentially a repeat of

the independent claims.  It does not benefit the reader for quickly and briefly understanding the

invention from the summary without going into the detailed description to actually understand

the invention since the summary is essentially a repeat of the independent claims.

Appropriate correction is required.

### *Claim Rejections - 35 USC § 102*

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the

basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1 – 24 are rejected under 35 U.S.C. 102(b) as being anticipated by Cardno (WO 02/08954).

Regarding independent claims 1, 9, and 17, Cardno discloses a record 82 that collects interactive data where the record comprises a merchant identifier, customer identifier, date and/or time, cash value of any transactions, goods/services identifier (page 6, lines 6 – 29 and Figures 3 and 4), which reads on the claimed data memory in which is maintained one or more fact data sets comprising an identifier and one or more attributes. Cardno discloses the system recognizing patterns and mapping customers who view a site between a certain range in time (page 13, lines 28 – 34), which reads on the claimed members of each finite data set defines the range of possible values for at least one attribute of at least one fact data set. Cardno also discloses retrieving data (page 6, lines 27 – 29 and page 10, lines 8 – 10) and though Cardno did not explicitly disclose a retrieval component, it is inherent that Cardno's system has a retrieving component as Cardno's system retrieves records from the database, which reads on the claimed retrieval component arranged to retrieve one or more data sets from the memory. Cardno also discloses a graphical spatial representation in the form of a topographical map where the topographical map is arranged to show the origin and where the scale can be altered and where the representation of data displays a particular value at a fine set of points in the representation (page 7, line 14 – page 8, line 8 and Figures 4 and 10), which reads on claimed display component arranged to display a graphical representation of a chosen subset of the set of all fact data sets in the memory as a series of data values.

Regarding dependent claims 2, 3, 10, 11, 18, and 19, Cardno discloses a circular graph and a circular representation (Figure 10), which reads on the claimed graphical representation having a substantially circular configuration and the claimed graphical representation comprises a circular graph.

Regarding dependent claims 4, 5, 12, 13, 20, and 21, Figure 10 shows segments and sub-segments matching their respective member of their finite data set and an attribute of at least one member of the chosen subset of the set of all fact data sets (page 11, line 4 – page 13, line 26 and Figures 7 – 11), which reads on the claimed data visualization system arranged to retrieve one finite data set and divide the graphical representation into two or more segments, each segment matching a member of one of the fine element sets and an attribute of at least one member of the chosen subset of the set of all fact data sets and the claimed data visualization system arranged to retrieve a further finite element data set and divide each segment into one or more sub-segments, each sub-segment matching a ember of the further finite data set and an attribute of at least one of the members of the chosen subset of the set of all fact data sets included in the segment.

Regarding dependent claims 6, 7, 14, 15, 22, and 23, Figure 10 shows fact sets being represented by nodes and shows nodes in a circular pattern and new nodes in larger circular pattern where the each node for each circle are the same distance from the center corresponding to their respective circular pattern, which reads on the claimed chosen subset of the set of all fact data sets is represented by one or more nodes within the representation and the claimed graphical representation is arranged to create a new circle of nodes on the outer circumference of the graph whenever the graph divides, the number of nodes equl to the number of new segments, and each node in the new circle substantially the same distance from the centre of the graph.

Regarding dependent claims 8, 16, and 24, Cardno discloses the value at each web site object is preferably represented as a contoured representation, having a defined value at the center of the point with values around the representation dropping away gradually between data points and where the data points with large values are represented as higher peaks than other data points with lower values (page 13, lines 13 – 18), which reads on the claimed superimposed contoured data representations around each node in the representation such that each data point is displayed as a local maximum.

## *Conclusion*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jeffrey J. Chow whose telephone number is (571)272-8078. The examiner can normally be reached on Monday - Friday 10:00AM - 5:00PM (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ulka Chauhan can be reached on (571)-272-7782. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

ULKA CHAUHAN
SUPERVISORY PATENT EXAMINER

## Notice of References Cited

| | Application/Control No. | Applicant(s)/Patent Under Reexamination |
|---|---|---|
| **Notice of References Cited** | 10/642,789 | CARDNO, ANDREW. JOHN |
| | Examiner | Art Unit | |
| | Jeffrey J. Chow | 2672 | Page 1 of 1 |

### U.S. PATENT DOCUMENTS

| * | | Document Number<br>Country Code-Number-Kind Code | Date<br>MM-YYYY | Name | Classification |
|---|---|---|---|---|---|
| | A | US- | | | |
| | B | US- | | | |
| | C | US- | | | |
| | D | US- | | | |
| | E | US- | | | |
| | F | US- | | | |
| | G | US- | | | |
| | H | US- | | | |
| | I | US- | | | |
| | J | US- | | | |
| | K | US- | | | |
| | L | US- | | | |
| | M | US- | | | |

### FOREIGN PATENT DOCUMENTS

| * | | Document Number<br>Country Code-Number-Kind Code | Date<br>MM-YYYY | Country | Name | Classification |
|---|---|---|---|---|---|---|
| | N | WO 200208954 A1 | 01-2002 | WIPO | CARDNO, A J | |
| | O | WO 200269192 A1 | 09-2002 | WIPO | CARDNO, A J | |
| | P | | | | | |
| | Q | | | | | |
| | R | | | | | |
| | S | | | | | |
| | T | | | | | |

### NON-PATENT DOCUMENTS

| * | | Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages) |
|---|---|---|
| | U | |
| | V | |
| | W | |
| | X | |

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification⁷: G06F 17/30, 17/60

(21) International Application Number: PCT/NZ01/00138

(22) International Filing Date: 10 July 2001 (10.07.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
505662    10 July 2000 (10.07.2000)    NZ

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(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— with international search report
— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: CUSTOMER ACTIVITY TRACKING SYSTEM AND METHOD
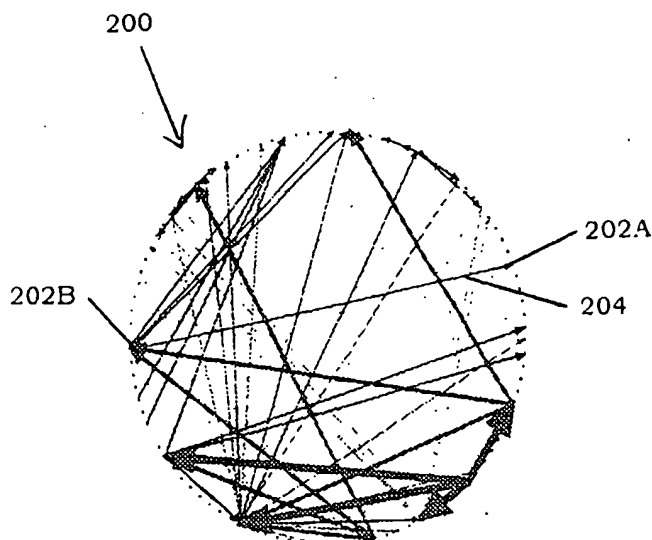
(57) Abstract: The invention provides a data visualisation system, in particular a website activity tracker which comprises a data value memory in which is maintained a finite set of data values; a display arranged to display a representation (200) of each data value centered on respective data points (202A, 202B), a plurality of the data points (202A, 202B) positioned in a circular arrangement; and a relationship generator arranged to generate and display relationships (204) between one or more pairs of the data points (202A, 202B) positioned in a circular arrangement. The invention also provides related methods and computer programs.

# CUSTOMER ACTIVITY TRACKING SYSTEM AND METHOD

## FIELD OF INVENTION

5      The invention relates to a data visualisation system and method and more particularly relates to a customer website activity tracking system and method.

## BACKGROUND TO INVENTION

10     It is becoming increasingly common for merchants to operate web sites as part of their business. To compete effectively, it is necessary for a merchant to be able to identify and action information collected from the use that is made of these web sites. The task of identifying this hidden information has proved very difficult for merchants.

15     It would be very useful for a merchant to have the collected data presented in a graphical manner, particularly where the data is to be displayed to a non-technical audience. It would also be beneficial for a merchant to formulate different queries for the collected data without requiring technical knowledge.

20     ## SUMMARY OF INVENTION

In broad terms in one form the invention comprises a data visualisation system comprising a data value memory in which is maintained a finite set of data values; a display arranged to display a representation of each data value centered on respective data points; and a contour
25     generator arranged to generate and display a contoured representation around each data point such that each data point is displayed as a local maximum.

In a further preferred form the invention comprises a data visualisation system comprising a data value memory in which is maintained a finite set of data values; a display arranged to
30     display a representation of each data value centered on respective data points; and a contour generator arranged to generate and display one or more contour lines around each data point, each contour line representing data values which are less than the data value of the data point around which the contour line is displayed.

In another preferred form the invention comprises a data visualisation system comprising a data value memory in which is maintained an interaction database of interaction data representing interactions between customers and merchants; a retrieval device arranged to retrieve from the interaction database data representing interactions between customers and 5    merchants and to construct a finite set of data values from the retrieved data; and a display arranged to display a graphical representation of at least one merchant and to superimpose a contoured representation of the data values on the graphical representation of the merchant, such that each data value is displayed as local maximum.

10   In another preferred form the invention comprises a method of data visualisation comprising the steps of maintaining in a data value memory a finite set of data values; displaying a representation of each data value centered on respective data points; and generating and displaying a contoured representation around each data point such that each data point is displayed as a local maximum.

15

In a further preferred form the invention comprises a method of data visualisation comprising the steps of maintaining in a data value memory a finite set of data values; displaying a representation of each data value centered on respective data points; and generating and displaying one or more contour lines around each data point, each contour line representing 20   data values which are less than the data value of the data point around which the contour line is displayed.

In yet another preferred form the invention comprises a method of data visualisation comprising the steps of maintaining in an interaction database interaction data representing 25   interactions between customers and merchants; retrieving from the interaction database data representing interactions between customers and merchants; constructing a finite set of data values from the retrieved data; displaying a graphical representation of at least one merchant; and superimposing a contoured representation of the data values on the graphical representation of the merchant, such that each data value is displayed as a local maximum.

30

In a further preferred form the invention comprises a data visualisation computer program which enables maintaining in a data value memory a finite set of data values; displaying a representation of each data value centered on respective data points; and generating and

displaying a contoured representation around each data point such that each data point is displayed as a local maximum.

In a further preferred form the invention comprises a data visualisation computer program which enables maintaining in a data value memory a finite set of data values; displaying a representation of each data value centered on respective data points; and generating and displaying one or more contour lines around each data point, each contour line representing data values which are less than the data value of the data point around which the contour line is displayed.

In yet a further preferred form the invention comprises a data visualisation computer program which enables maintaining in an interaction database interaction data representing interactions between customers and merchants; retrieving from the interaction database data representing interactions between customers and merchants; constructing a finite set of data values from the retrieved data; displaying a graphical representation of at least one merchant; and superimposing a contoured representation of the data values on the graphical representation of the merchant, such that each data value is displayed as a local maximum.

In yet a further preferred form the invention comprises a data visualisation system comprising a data value memory in which is maintained a finite set of data values; a display arranged to display a representation of each data value centered on respective data points, a plurality of the data points positioned in a circular arrangement; and a relationship generator arranged to generate and display relationships between one or more pairs of the data points positioned in a circular arrangement.

In a further preferred form the invention comprises a method of data visualisation comprising the steps of maintaining in a data value memory a finite set of data values; displaying a representation of each data value centered on respective data points, a plurality of the data points positioned in a circular arrangement; generating and displaying relationships between one or more pairs of the data points positioned in a circular arrangement.

In a further preferred form the invention comprises a data visualisation computer program which enables maintaining in a data value memory a finite set of data values; displaying a representation of each data value centered on respective data points, a plurality of the data

points positioned in a circular arrangement; generating and displaying relationships between one or more pairs of the data points positioned in a circular arrangement.

## BRIEF DESCRIPTION OF THE FIGURES

5

Preferred forms of the customer activity tracking system and method will now be described with reference to the accompanying Figures in which:

Figure 1 shows a block diagram of an Internet-based system in which the invention may be
10    implemented;

Figure 2 shows the preferred system architecture of hardware on which the present invention may be implemented;

15    Figure 3 shows an interaction between a customer and a merchant and the migration, retrieval and display of data obtained from the interaction;

Figure 4 shows a typical representation generated and displayed by the invention as showing a customer provenance map and merchant store representation;

20

Figure 5 shows another representation generated and displayed by the invention as showing the site map of a merchant web site;

Figure 6 shows the site map of Figure 5 configured to identify traffic flow; and

25

Figure 7 shows a further representation generated and displayed by the invention showing the site map of a merchant web site;

Figures 8 and 9 are variations of the representation of Figure 7;

30

Figure 10 is a representation of a merchant web site with contoured data included; and

Figure 11 shows a web site usage profile generated and displayed by the invention.

## DETAILED DESCRIPTION OF PREFERRED FORMS

Figure 1 illustrates a block diagram of the preferred Internet-based system 10 in which the present invention may be implemented. The system includes one or more clients 20, for

5   example clients 20A, 20B and 20C, which each may comprise a personal computer or workstation which will be described below. Each client 20 is interfaced to the Internet 22. As shown in Figure 1, each client 20 could be connected directly to the Internet with a suitable dial-up connection or could be connected through a local area network or LAN. Client 20C is shown as connected to the Internet 22 with a dial-up connection. Clients 20A and 20B, on the

10  other hand, are connected to a network 24, such as a local area network or LAN. The network 24 could be connected to a suitable network server 26 and communicate with the Internet 22 as shown.

The system 10 also includes one or more web servers 30, for example web server 30A and

15  30B. Each web server 30 is connected to the Internet 22 as shown in Figure 1. Each web server 30 preferably comprises a personal computer or workstation operating under the control of suitable software. Connected to web servers 30 are one or more merchant computers or workstations 40, for example merchant 40A, 40B and 40C. Two or more merchants could be connected to the same web server as is the case with merchant 40A and

20  merchant 40B both connected to web server 30A. Alternatively, merchant 40C, for example, could be connected to dedicated web server 30B.

Figure 2 shows the preferred system architecture of a client 20, web server 30 or merchant 40 computer or workstation. The computer system 50 typically comprises a central processor 52,

25  a main memory 54, an input/output controller 56, a keyboard 58, a pointing device 60 for example a mouse, a display or screen device 62, a mass storage 64, for example a hard disk, floppy disk or optical disc, and an output device 66 for example a printer. The computer system 50 could also include a network interface card or controller 68 and/or a modem 70. The processor 52 could also include or be interfaced to a cache memory 72 which could be

30  arranged as an on-chip cache or external cache. The individual components of system 50 could communicate through a system bus 74.

Referring to Figure 3, a customer on client workstation 20 interacts with a merchant 40. The merchant 40 could include an individual, a company or organisation and will typically operate

a web site or other electronic medium through which customer 20 purchases goods or services. The merchant may alternatively operate an on-line casino, gambling or other gaming facility. The merchant could also offer transport and delivery, financial or banking services.

5

Customer 20 could include an individual, a company or organisation. The customer could be a purchaser of goods or services from the merchant or could simply be visiting a web site operated by the merchant. An interaction between a customer 20 and a merchant 40 could be initiated by either the customer or by the merchant. As the customer 20 interacts with

10    merchant 40, the interaction generates interaction data which is collected as indicated at 80. A typical record of collected interaction data is shown at 82. The record could include, for example, a merchant identifier. This merchant identifier could be used to identify a particular merchant and could comprise the universal resource locator (URL) of a web site operated by the merchant, or an Internet protocol (IP) address for the merchant. The record 82 could also

15    include a customer identifier. The customer identifier could include the IP address or other network address of the customer client 20. The customer identifier could alternatively comprise a character string assigned to the customer by the merchant during a registration process with a facility for the customer to supply a user name and password to initiate an interaction in the known way.

20

The record 82 could also include the universal resource locator (URL) of a web page visited by the customer 20 during an interaction. The record 82 could also include other data such as the date and/or time at which the interaction between the customer and the merchant took place, the cash value of any transaction if applicable, and a goods/services identifier where a

25    transaction has taken place. It is envisaged that each new URL visited by a customer, for example each new page visited in a merchant web site, generates a new interaction record. By retrieving and sorting these records by date and time, it is possible to calculate the number of customers visiting a particular web site and the average time spent at a particular web page or page cluster, as will be more particularly described below.

30

The interaction data is migrated to memory 54 of a suitable personal computer or workstation 50 as indicated at 84. Preferably the interaction data is stored in a data repository for example a data warehouse 86. It is envisaged that the data repository may alternatively comprise a single database, a collection of databases, or a data mart. The data warehouse could also

include data from other sources, for example, census data, data from a merchant-customer
database, data from a merchant loyalty programme and/or promotion data held by a merchant.

5       The system retrieves data representing interactions between customers and merchants from
the data warehouse 86 as indicated at 88. Preferably the system permits a user to specify the
data to be retrieved, as will be more particularly described below.

After data retrieval, the system displays the data as indicated at 90, preferably as a graphic
representation of the data on a screen display 62 of a suitable workstation. The representation
10      of the data preferably includes animated visualisations (AVIs) or still images (stills) of web
site usage by customers and the provenance or origin of those customers over the course of a
trading period.

Figure 4 shows a typical representation generated by the system. The display could include a
15      customer provenance window 100. The preferred customer provenance window displays a
graphical spatial representation in the form of a topographical map. The map is arranged to
show the origin of customers interacting with a particular merchant. It will be appreciated
that the scale of the map could be altered, depending on the customer base under
consideration. The map could include a detailed map, such as that shown in Figure 4 showing
20      suburbs in a particular city, could alternatively show individual cities in a particular country,
or could be a global map showing all countries.

The system may present the data to the user based on one of a number of key performance
indicators (KPIs) which could include total sales, gross profit, net profit, gross margin return
25      on inventory investment (GMROII), net margin return on inventory investment (NMROII),
return on net asset (RONA), loyalty sales data, time spent viewing a particular web site or
page and/or a web page visitation percentage. Each representation could show for example a
combination of number of customers, the number of sales and gross profit as is the case in
Figure 4.

30

The preferred representation of data displays a particular value at a finite set of points in the
representation, for example points 102A, 102B, 102C, 102D, 102E, 102F and 102G in Figure
4. The areas of representation around each data point are shown as a series of contour lines.
The nature of the contours for each data point are preferably represented to gradually drop off

8

or fall away from each data point. Each data point could be represented by x and y co-ordinates indicating the relevant position of each data point in the representation. Each data point could also have a z value representing the height or magnitude of the data point. This z value could indicate, for example, the time spent viewing a particular website and/or web page, or the revenue generated from a particular web page. The contour lines represent z data values which are less than the data value of the data point around which the contour lines are displayed. In this way, each data value is centered on a data point. Each data point is displayed as a local maximum as surrounding values drop off or fall away around each point.

This contoured method of representing data values is more particularly described in our patent specification WO 00/77862 to Compudigm International Limited filed on 14 June 2000 entitled "Data Visualisation System and Method" which is incorporated by reference. The data value of each data point represents the apex of a bell-shaped curve. As x and y values in the representation are increased or decreased, the z value at the new position in the presentation will change.

The customer provenance map 100 shown in Figure 4 illustrates that the customers contributing to the largest KPI values, have a provenance or point from which they interact with a particular merchant which is centred on point 102E. Customers contributing to the lowest KPI values for the merchant have a provenance at point 102G. It will be readily inferred from such a representation that the most valuable customers are based around point 102E.

As described above with reference to Figure 3, each interaction record 82 includes a customer identifier. This customer identifier could be linked to a physical address, within the requirements of any privacy restrictions, provided to a merchant by a customer at the time of registration or log-on. Alternatively, a geographic location could be inferred from the interaction itself. For example, a client workstation used by a customer may use a particular network or Internet address from which a country code or indicator could be extracted. This would at least provide customer provenance data to country level.

Referring to Figure 4, the system could also generate and display a representation of the merchant as indicated at 110. Where a merchant offers a range of goods or services, the representation 110 could comprise a graphical spatial representation of a "virtual store". The

virtual store plan could show virtual positions of a door 112, a service counter and one or more shelves 114 on which products are displayed. Where a merchant operates in a commercial premises or store in conjunction with a web site, it is envisaged that the representation 110 could comprise the actual graphical spatial representation of the store. Where a merchant operates from two or more retail stores, the graphical representation could include spatial representations of each store and could also include a large scale map of the geographical area in which the merchants stores are located.

The representation 110 preferably shows distinct product types spaced over the representation. As described above with reference to Figure 3 each interaction record 82 may include goods/services ID which could be grouped into product types. Each product type or grouping in the representation could represent a data point which is contoured in the same way as the customer provenance map 100 described above. Typical store plan data points are indicated at 116A, 116B and 116C. KPI values at individual points 116A, 116B and 116C are displayed as peaks, and values of areas between these data points are shown as contours in the same way as that described above.

The display could also include a progress bar as indicated at 120. The progress bar 120 could include an analogue time display 122 and date information for a particular visualisation. The presentation could also display one or more KPIs, for example the number of customers, number of sales and gross profit for a particular visualisation and also display totals, cumulative totals and cumulative percentages.

It is envisaged that the representation shown in Figure 4 could be presented to a user as a still image or still. Alternatively, the user could be presented with a series of time consecutive visualisations forming an animated visualisation or AVI. The analogue time display 122 would show the user the progress of the AVI. It is also envisaged that the main screen could also include progress bars indicated at 124 which present a sliding scale of cumulative KPI totals to a user as the animation progresses.

The system is preferably also arranged to display a graphical site map of a merchant's web site. Figure 5 illustrates one preferred form representation. Web site pages or page clusters are indicated, for example, as boxes 140A, 140B, 140C, 140D, 140E and 140F. Each box is

preferably shown with a page or page cluster number and a percentage representing the percentage of users visiting the web site who have viewed the particular page or page cluster.

For example, 100% of users visiting the web site have visited the home page shown as 140A.

5    Web page 140B, which is accessible from web page 140A, has been visited by 28% of users. Web page 140C, which is accessible from web page 140A, has been visited by 71% of users.

By retrieving a set of records from the interaction database using a customer identifier as a key, and then sorting these records by date and time, the usage of a web site by an individual

10   customer can be tracked and displayed in accordance with the invention.

In a preferred form, the representation shown in Figure 5 could have superimposed on it a representation of the data retrieved from the interaction database in the form of a series of ripple contours, with those web pages attracting high usage being contoured as peaks. It will

15   be appreciated that the KPI on which the representation is contoured could include any one or more of the KPIs discussed above, for example, total sales, gross profit, net profit and the like.

As shown in Figure 5, the user could also be presented with a legend 142 for shading relating

20   to particular percentage values of visitation for each web page or page cluster.

Referring to Figure 6, the system may also be arranged to show traffic flow associated with a nominated page or page cluster. The user may be permitted to click for example on page representation 140D in the display, causing this page to be highlighted. Contributing pages

25   140B and 140C are highlighted as are destination pages 140E and 140F. The remaining web pages are greyed out. Customer traffic flow between web pages is preferably shown proportionally by the size of linking arrows. For example, the arrow linking web page 140B to 140D is thinner than the arrow linking web page 140C to 140D, indicating that web traffic from web page 140C to 140D is greater than web traffic from web page 140B to 140D. It is

30   envisaged that the colour of the arrows could also be varied to represent traffic flow.

The system is also preferably arranged to calculate and display web site usage patterns. By retrieving a set of records from the interaction database using a customer identifier as a key, and sorting the records by date and time, the system can calculate how long a particular

customer spends viewing a particular web page or URL by calculating the difference in time between successive interaction records involving different web pages or URLs.

Figure 7 illustrates a further preferred form representation 200 of a graphical site map of a merchant's web site. The representation 200 is formed by representing each web site page as a data point shown as a dot or icon, for example 202A and 202B, substantially equally spaced around the circumference of a circle or at least in a circular arrangement.

In one form of the invention, a relationship generator could comprise a computer-implemented software program programmed to generate and display relationships between one or more pairs of the data points positioned in the circular arrangement. For example, the relationship generator generates and displays relationship 204 between data points 202A and 202B. Each relationship could represent, for example, web traffic between website pages. In Figure 7, for example, there is a degree of web traffic from the website page represented by data point 202B to the website page represented by data point 202A. The direction of web traffic is indicated by a directional arrow. It is envisaged that the relationship generator could also display an indicator of web traffic magnitude between pairs of website pages. This indicator of website magnitude could include line thickness. For example, a thicker line or arrow between two data points could represent greater web traffic than a thinner line.

The size, colour, style and/or stipple of each arrow could be varied to show direction and magnitude of traffic flow between the respective web pages, or any other KPI described above, for example, total sales, gross profit, net profit, gross margin return on inventory investment (GMROII), net margin return on inventory investment (NMROII), return on net asset (RONA), loyalty sales data, time spent viewing a particular web site and/or a web page visitation percentage.

The relationship between respective web pages could be one-to-one, one-to-many or many-to-one. The visual images could be filtered to only show some relationships/graphics. The representation could show, for example, only relationships between nodes in one direction. The representations could also be segmented to emphasise related page clusters and other information.

Figure 8 shows another preferred representation 250 in which the object or web page having the largest value of a specified KPI becomes the central object in the summary image as indicated at 252 in representation 250. A web page having the largest value of a specified KPI could be displayed as a first data point in the centre of a circle. The remaining data

5    points could be displayed in a circular arrangement around the first data point.

The direction and magnitude of traffic between website pages is also represented in Figure 8 in the same manner as Figure 7.

10   As shown in Figure 9, a further representation 300 could show the largest value KPI in the centre as indicated at 302. Further high value objects could be spaced equidistant from the centre shown at 304A, 304B, 304C, 304D and 304E. These objects 304 could represent a second tier of KPI values. The criteria for inclusion in this second tier could be user defined, and could include the next X objects, for example X=4, that have the largest volume of some

15   KPI, or a volume above a predefined threshold.

Data point 302 having the largest KPI value is positioned in the centre of the circle. The user could specify a predefined KPI threshold and display all data points having data values exceeding this predefined threshold in a circular arrangement around data point 302.

20   Examples in Figure 9 are 304A, 304B, 304C, 304D and 304E. Each of the data points 304 is preferably positioned at substantially equal distances from data point 302.

The remaining data points not exceeding the predefined threshold are presumably of less relevance to the user and are positioned around the circumference of the larger circle. The

25   remaining data points are preferably spaced a greater distance from data point 302 than each of data points 304.

It is envisaged that the threshold criteria will vary according to the nature of the data being compared. For example, data points 304 could be determined if they exceed a predefined

30   threshold value or if they are less than a predefined threshold, depending on whether a low or high data value is of interest to the user.

The representations could include three, four or more tiers as required by the user. The representations could have their hierarchy imposed on them by the user specifying that a particular node be the central node.

5    In each of Figures 8, 9 and 10, a plurality of data points are arranged in a substantially circular arrangement.

Figure 10 shows a further preferred form representation 350 in which the largest value KPI object is shown as the central object 352, with several tiers of objects radiating outwardly 10    from the central object. Links could be shown connecting objects, and these links could be displayed with or without directional arrows.

The preferred representation 350 displays KPI values as contoured representations similar to the representations described above with reference to Figure 4. The value at each web site 15    object is preferably represented as a contoured representation, having a defined value at the centre of the point with values around the representation dropping away gradually between , data points. Data points with large values, for example 352, are represented as higher peaks than other data points with lower values.

20    By compiling usage patterns for individual customers, the system can develop and display a profile of site usage, for example as shown in Figure 11 in which a merchant operates a web site having four web page or page clusters. These could include for example a front page or menu 640, a second web page 642 which elicits from the user a customised shopping list, a third web page 644 providing delivery and/or payment options, and a fourth web page 646 25    arranged to display specials to a user and permit the user to select one or more of these specials.

The system may recognise several patterns in site usage. For example, pattern 1 could comprise 31% of all users who spend between 5 and 20 seconds viewing web page 640 and 30    then exit. Referring to pattern 2, 12% of users could spend between three and ten seconds on web page 640, between 0.5 and 5 minutes on web page 642, between 10 and 25 seconds on web page 644 and then exit. Pattern 3 could comprise 7% of users who spend 3 to 10 seconds on web page 640, 1.5 to 3 minutes on web page 642, spend 3 to 12 minutes on web page 646, spend 10 to 20 seconds on web page 644 and then exit.

The system could recognise these patterns of repeated web page and page cluster visitation and usage. It could rank these patterns based on the percentage of web site visitors that the pattern includes, and display details such as the pattern percentage, the average time spent at

5    each page or page cluster as indicated at 650, and the resultant KPIs of different usage patterns. The system could display for example a finite number of most common usage patterns, the number being defined by the user.

The system could also be arranged to record and display further patterns of use of particular

10   web pages. It is envisaged that the interaction database 82 could be arranged to store further interaction data, for example the areas of a web page from which a particular user makes selections or into which a user types data, the areas to which a mouse pointer operated by a user is tracked and clicked while in the web site, known as the click source, and also the URL(s) of the source web page visited by a user prior to visiting the web page under

15   consideration, and/or the destination web page visited by the user after visiting the web page under consideration.

The preferred system displays to the user several options for the retrieval and display of data. The system may include, for example, a visualisation Wizard implemented in a Microsoft

20   Windows environment. It is envisaged that known equivalents may replace the Wizard when the system is implemented in different environments such as Apple, Sun Microsystems, or Unix/Linux environments. The preferred wizard enables a user to create a synchronised pair of AVIs or stills, together with associated web site visitation and usage. The preferred wizard also enables a visualisation to be tailored to show a specific web site usage by requiring

25   selections to be made for:

- Geographic area
- Customer profile or snapshot
- The KPI that the customer provenance map will contour
30 - Labels for the customer provenance map
- The KPI that the web site usage map will contour
- Labels for the web site usage map
- KPI progress bars (if any) are included

- What published KPI statistics (if any) are included
- Labels for the web page usage diagram
- Shading for the web page usage diagram
- AVI start and finish dates and times and scheduling options
- AVI frame frequency, for example a new frame every 5 minutes, 10 minutes, 30 minutes, etc
- Name description and cataloguing options

The system may also be arranged to perform customer loyalty and marketing functions. The invention could provide the user with several options for generating mailing lists of web site users according to a particular criteria. For example, the system could generate a mailing list for those customers who have used a site, or those who fit a particular pattern of site usage as described above. The system could identify regular users of the site, calculate an approximate frequency of site usage, identify trends of increasing or decreasing usage across subsequent visits, and/or produce a list of those whose site usage changes for some reason.

For example, the system could identify weekly shoppers who miss a week's order, customers who browse the "weekly specials" page, customers who have started to visit a particular web page after being included in a promotional mail out, and whether the customer is making purchases as a result. The system could also be arranged to assemble mailing lists of those users who make heavy usage of help pages.

It will be appreciated that a merchant operating a web site is vulnerable to attacks from what may appear to be genuine customers. These hackers often attempt to gain unauthorised access to a web site and either change the web site in some fashion by altering the text displayed on the web site, installing unauthorised computer programs or software on the web site, or retrieving data or computer programs from a web site without authorisation from the merchant.

Using the interaction database 82 described above with reference to Figure 3, supplemented with activity logs which routinely capture and store activity on a web site, the system could compile and display profiles of unauthorised customers. The system could display, for

example, a customer provenance window such as that described above with reference to Figure 4.

It is envisaged that the system could build weekly or monthly reports listing any identified

5   hacker attempts and details of these attempts with representations summarising their provenance or locations. In this way, a merchant could identify and build a profile of hacker activity directed to their organisation, enabling the merchant to identify individual hackers, pinpoint their own security weaknesses and to develop strategies to counter unauthorised activity.

10

In summary, the system and method of the invention permits a user to examine a visualisation of interaction data between customers and merchants, particularly visualisations of customers visiting a web site operated by a merchant. Data visualisations, in particular the animated visualisations described above, are a useful complement to other reporting tools, such as

15   charts and graphs.

Using the system and method described above, a user may make sense of and obtain useful data from a data warehouse without requiring technical knowledge. For example, the user may identify optimal ordering of web page links on a merchant web site and select the most

20   desirable ordering and positioning of these links. The user may also identify correlations between sales of different goods or services and may also identify the effectiveness of loyalty programmes and other incentive schemes.

The foregoing describes the invention including preferred forms thereof. Alterations and

25   modifications as will be obvious to those skilled in the art are intended to be incorporated within the scope hereof.

**CLAIMS:**

1.      A data visualisation system comprising:

         a data value memory in which is maintained a finite set of data values;

5          a display arranged to display a representation of each data value centered on respective data points; and

         a contour generator arranged to generate and display a contoured representation around each data point such that each data point is displayed as a local maximum.

10   2.      A data visualisation system comprising:

         a data value memory in which is maintained a finite set of data values;

         a display arranged to display a representation of each data value centered on respective data points; and

         a contour generator arranged to generate and display one or more contour lines

15   around each data point, each contour line representing data values which are less than the data value of the data point around which the contour line is displayed.

3.      A data visualisation system as claimed in claim 1 or claim 2 further comprising:

         a memory in which is maintained an interaction database of interaction data

20   representing interactions between customers and merchants; and

         a retrieval device arranged to retrieve from the interaction database data representing interactions between customers and merchants, to construct the finite set of data values from the retrieved data and to store the data values in the data value memory.

25   4.      A data visualisation system comprising:

         a data value memory in which is maintained an interaction database of interaction data representing interactions between customers and merchants;

         a retrieval device arranged to retrieve from the interaction database data representing interactions between customers and merchants and to construct a finite set of data values from

30   the retrieved data; and

         a display arranged to display a graphical representation of at least one merchant and to superimpose a contoured representation of the data values on the graphical representation of the merchant, such that each data value is displayed as local maximum.

5.      A data visualisation system as claimed in claim 3 or claim 4 wherein the merchant operates from one or more websites which are accessed by customers over a computer network, each data point representing a merchant website page.

6.      A data visualisation system as claimed in any one of the preceding claims wherein the plurality of the data points are positioned in a circular arrangement.

7.      A method of data visualisation comprising the steps of:
        maintaining in a data value memory a finite set of data values;
        displaying a representation of each data value centered on respective data points; and
        generating and displaying a contoured representation around each data point such that each data point is displayed as a local maximum.

8.      A method of data visualisation comprising the steps of:
        maintaining in a data value memory a finite set of data values;
        displaying a representation of each data value centered on respective data points; and
        generating and displaying one or more contour lines around each data point, each contour line representing data values which are less than the data value of the data point around which the contour line is displayed.

9.      A method of data visualisation as claimed in claim 7 or claim 8 further comprising the steps of:
        maintaining in a memory an interaction database of interaction data representing interactions between customers and merchants;
        retrieving from the interaction database data representing interactions between customers and merchants;
        constructing the finite set of data values from the retrieved data; and
        storing the data values in the data value memory.

10.     A method of data visualisation comprising the steps of:
        maintaining in an interaction database interaction data representing interactions between customers and merchants;
        retrieving from the interaction database data representing interactions between customers and merchants;

constructing a finite set of data values from the retrieved data;

displaying a graphical representation of at least one merchant; and

superimposing a contoured representation of the data values on the graphical representation of the merchant, such that each data value is displayed as a local maximum.

11. A method of data visualisation as claimed in claim 9 or claim 10 wherein the merchant operates from one or more websites which are accessed by customers over a computer network, each data point representing a merchant website page.

12. A method of data visualisation as claimed in any one of claims 7 to 11 further comprising the step of positioning the plurality of data points in a circular arrangement.

13. A data visualisation computer program which enables:

maintaining in a data value memory a finite set of data values;

displaying a representation of each data value centered on respective data points; and

generating and displaying a contoured representation around each data point such that each data point is displayed as a local maximum.

14. A data visualisation computer program which enables:

maintaining in a data value memory a finite set of data values;

displaying a representation of each data value centered on respective data points; and

generating and displaying one or more contour lines around each data point, each contour line representing data values which are less than the data value of the data point around which the contour line is displayed.

15. A data visualisation computer program as claimed in claim 13 or claim 14 which further enables:

maintaining in a memory an interaction database of interaction data representing interactions between customers and merchants;

retrieving from the interaction database data representing interactions between customers and merchants;

constructing the finite set of data values from the retrieved data; and

storing the data values in the data value memory.

16.     A data visualisation computer program which enables:

maintaining in an interaction database interaction data representing interactions between customers and merchants;

retrieving from the interaction database data representing interactions between

5  customers and merchants;

constructing a finite set of data values from the retrieved data;

displaying a graphical representation of at least one merchant; and

superimposing a contoured representation of the data values on the graphical representation of the merchant, such that each data value is displayed as a local maximum.

10

17.     A data visualisation computer program as claimed in claim 15 or claim 16 wherein the merchant operates from one or more websites which are accessed by customers over a computer network, each data point representing a merchant website page.

15  18.     A data visualisation computer program as claimed in any one of claims 13 to 17 wherein the merchant operates from one or more websites which are accessed by customers over a computer network, each data point representing a merchant website page.

19.     A data visualisation computer program as claimed in any one of claims 13 to 18

20  embodied on a computer-readable medium.

20.     A data visualisation system comprising:

a data value memory in which is maintained a finite set of data values;

a display arranged to display a representation of each data value centered on

25  respective data points, a plurality of the data points positioned in a circular arrangement; and

a relationship generator arranged to generate and display relationships between one or more pairs of the data points positioned in a circular arrangement.

21.     A data visualisation system as claimed in claim 20 wherein the display is arranged to

30  display a first data point having the highest data value and to display the remaining data points in a circular arrangement around the first data point.

22.     A data visualisation system as claimed in claim 20 wherein the display is arranged to display a first data point having the highest data value, to display a plurality of data points

having data values exceeding a predefined threshold in a circular arrangement around and at substantially equal first distances from the first data point, and to display the remaining data points in a circular arrangement around and at substantially equal second distances from the first data point; the second distances greater than the first distances.

23.   A data visualisation system as claimed in any one of claims 20 to 22 wherein each data point represents a website page, the relationship generator arranged to display relationships representing web traffic between one or more pairs of website pages.

24.   A data visualisation system as claimed in claim 23 wherein the relationship generator is arranged to display an indicator of web traffic magnitude between pairs of website pages.

25.   A method of data visualisation comprising the steps of:
maintaining in a data value memory a finite set of data values;
displaying a representation of each data value centered on respective data points, a plurality of the data points positioned in a circular arrangement;
generating and displaying relationships between one or more pairs of the data points positioned in a circular arrangement.

26.   A method of data visualisation as claimed in claim 25 further comprising the steps of displaying a first data point having the highest data value; and displaying the remaining data points in a circular arrangement around the first data point.

27.   A method of data visualisation as claimed in claim 25 further comprising the steps of:
displaying a first data point having the highest data value;
displaying a plurality of data points having data values exceeding a predefined threshold in a circular arrangement around and at substantially equal first distances from the first data point; and
displaying the remaining data points in a circular arrangement around and at substantially equal second distances from the first data point;
the second distances greater than the first distances.

28.     A method of data visualisation as claimed in any one of claims 25 to 27 wherein each data point represents a website page, the method further comprising the step of displaying relationships representing web traffic between one or more pairs of website pages.

5    29.     A method of data visualisation as claimed in claim 28 further comprising the step of displaying an indicator of web traffic magnitude between pairs of website pages.

30.     A data visualisation computer program which enables:

maintaining in a data value memory a finite set of data values;

10    displaying a representation of each data value centered on respective data points, a plurality of the data points positioned in a circular arrangement;

generating and displaying relationships between one or more pairs of the data points positioned in a circular arrangement.

15    31.     A data visualisation computer program as claimed in claim 30 which further enables displaying a first data point having the highest data value; and displaying the remaining data points in a circular arrangement around the first data point.

32.     A data visualisation computer program as claimed in claim 30 which further enables:

20    displaying a first data point having the highest data value;

displaying a plurality of data points having data values exceeding a predefined threshold in a circular arrangement around and at substantially equal first distances from the first data point; and

displaying the remaining data points in a circular arrangement around and at

25    substantially equal second distances from the first data point;

the second distances greater than the first distances.

33.     A data visualisation computer program as claimed in any one of claims 30 to 32 wherein each data point represents a website page, the computer program further enabling

30    displaying relationships representing web traffic between one or more pairs of website pages.

34.     A data visualisation computer program as claimed in claim 33 which further enables displaying an indicator of web traffic magnitude between pairs of website pages.

35.     A data visualisation computer program as claimed in any one of claims 30 to 34 embodied on a computer-readable medium.
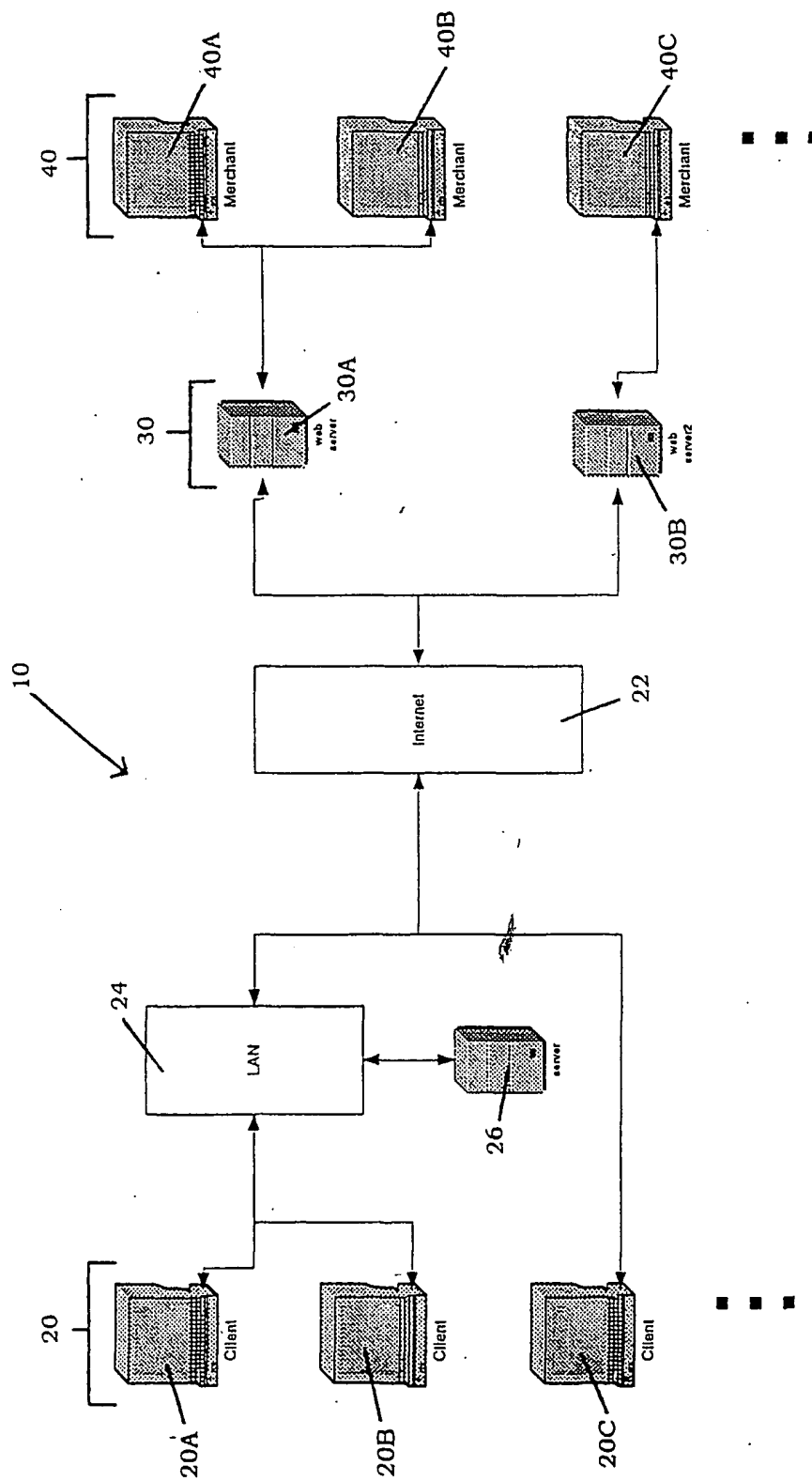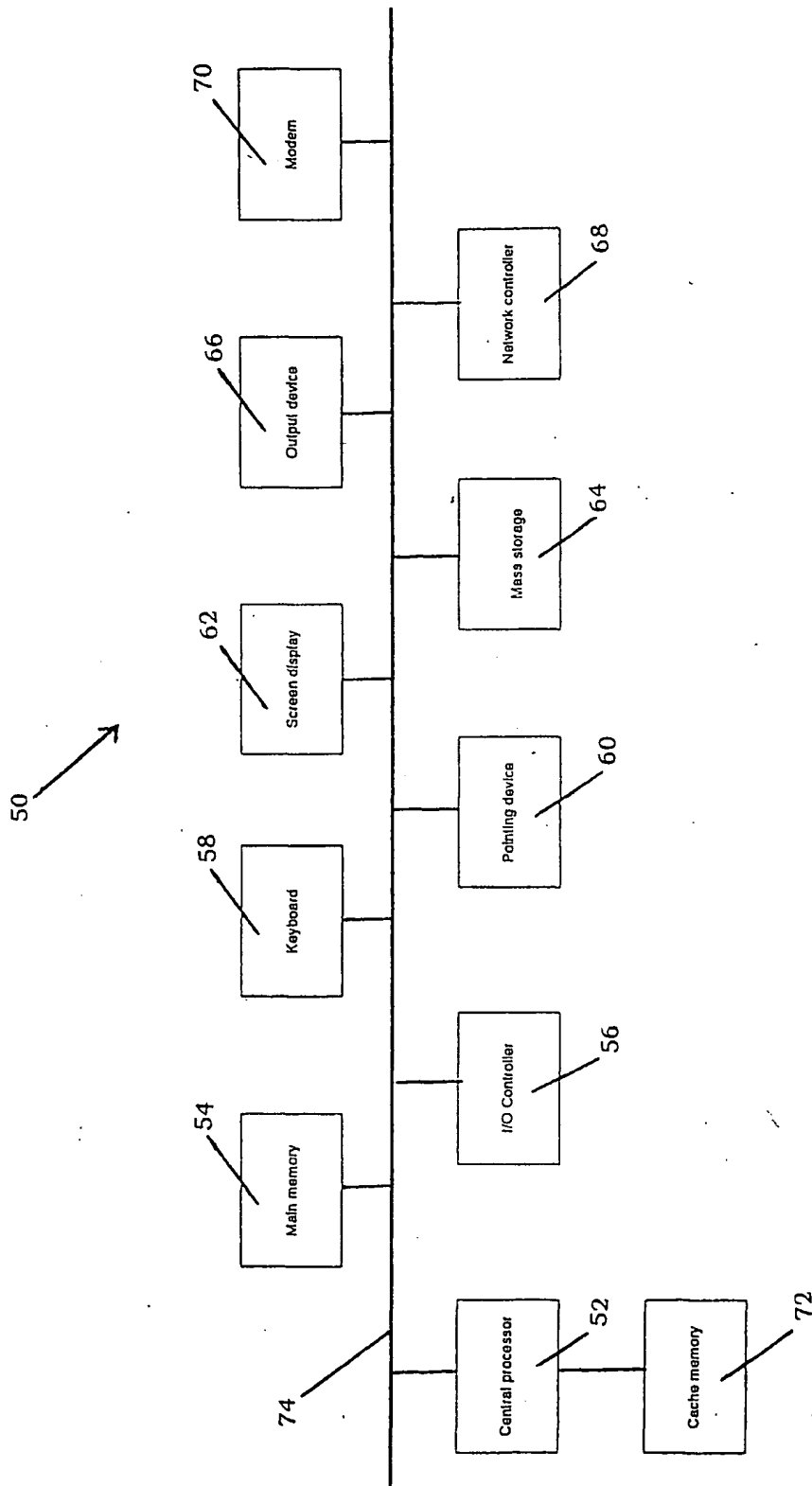
FIGURE 1

FIGURE 2
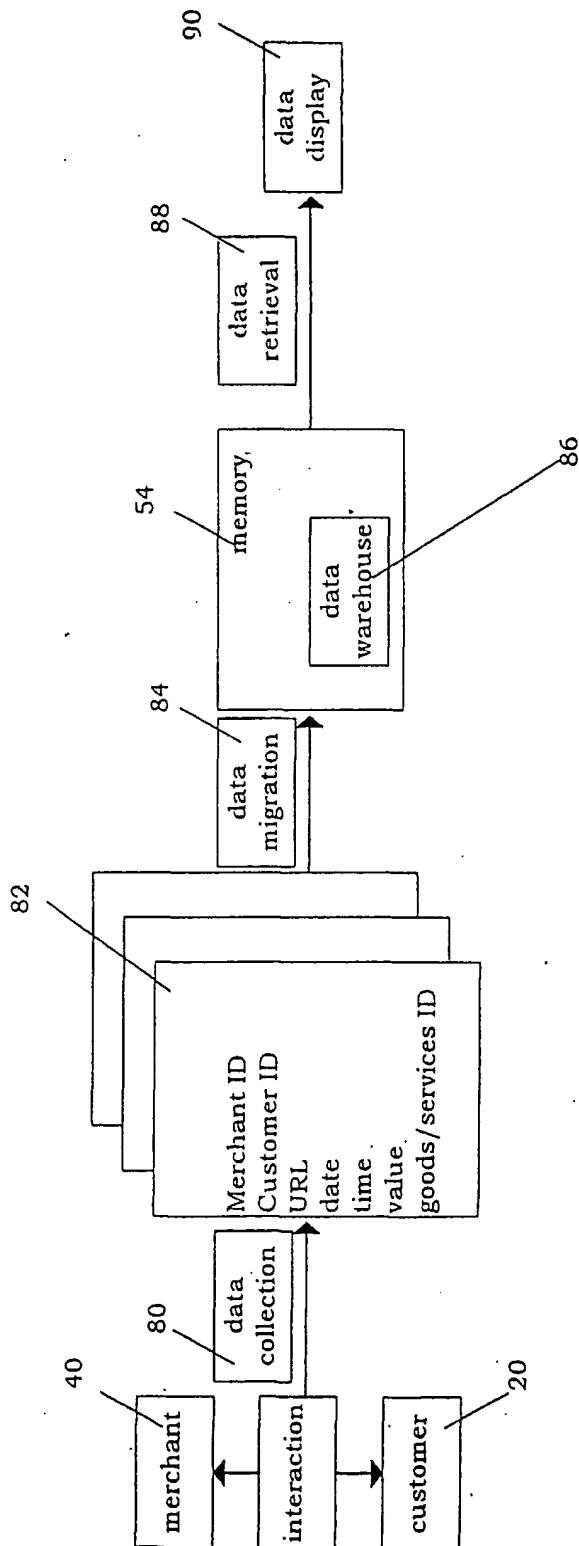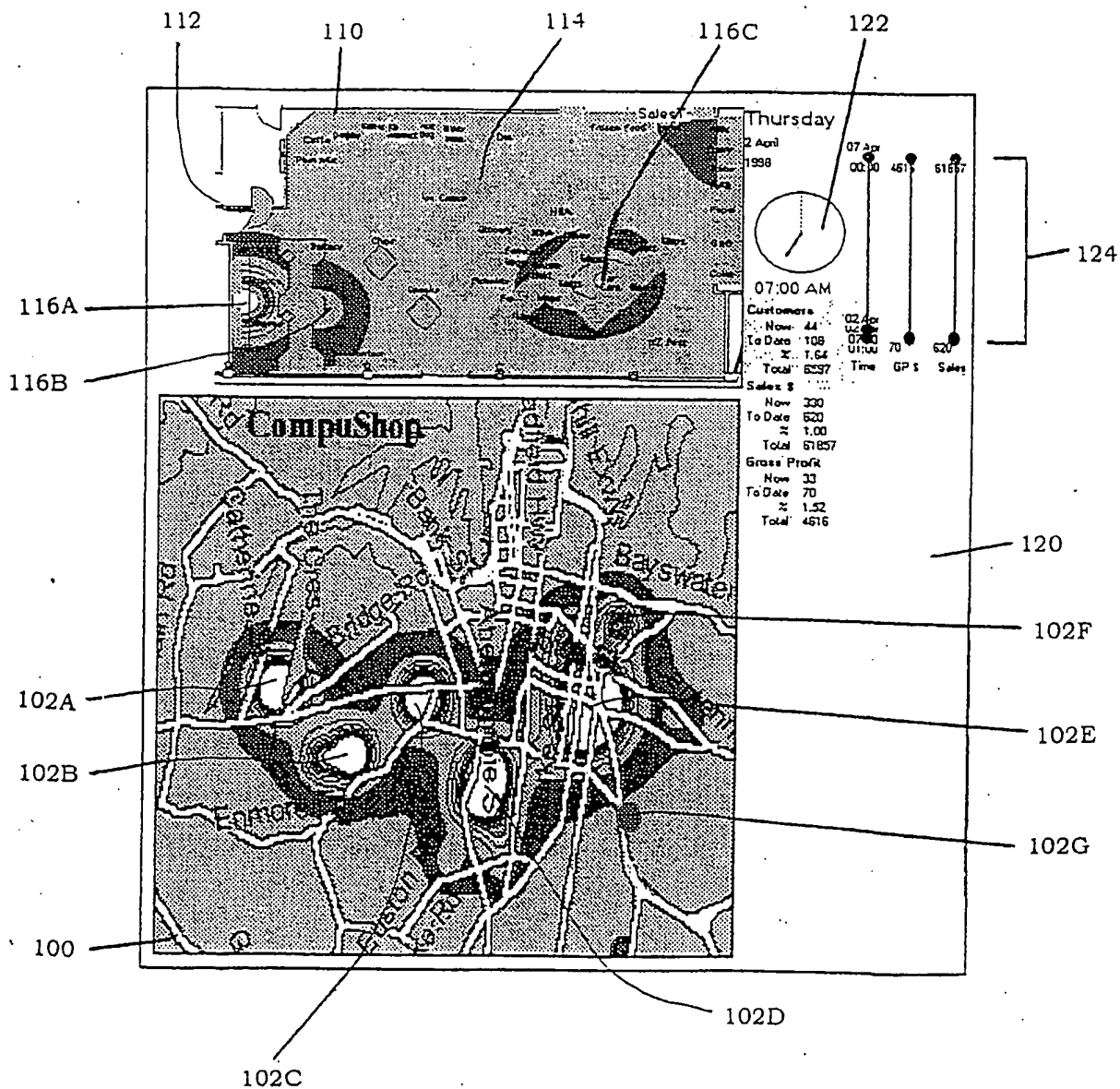
**FIGURE 3**

FIGURE 4

FIGURE 5

FIGURE 6

FIGURE 7

FIGURE 8

FIGURE 9

350

352
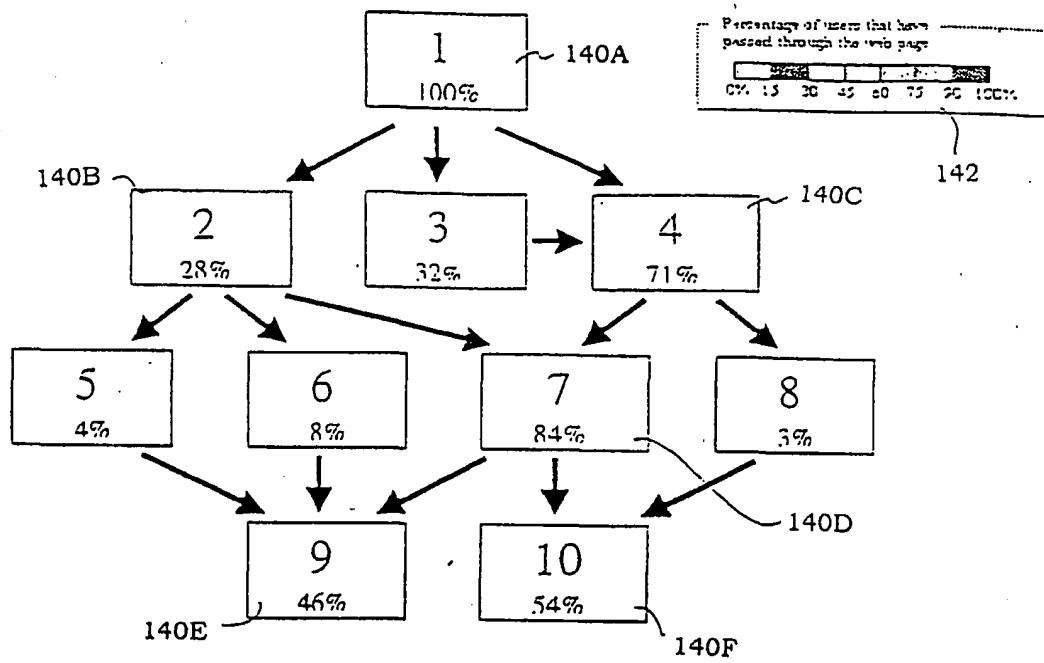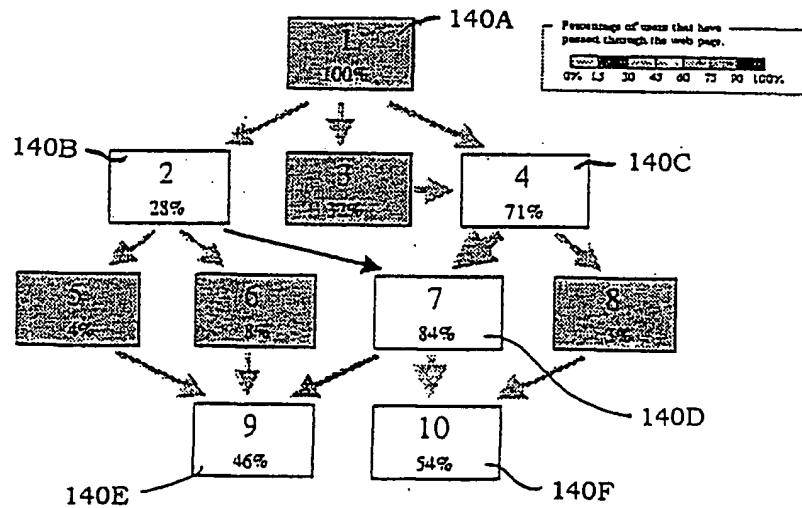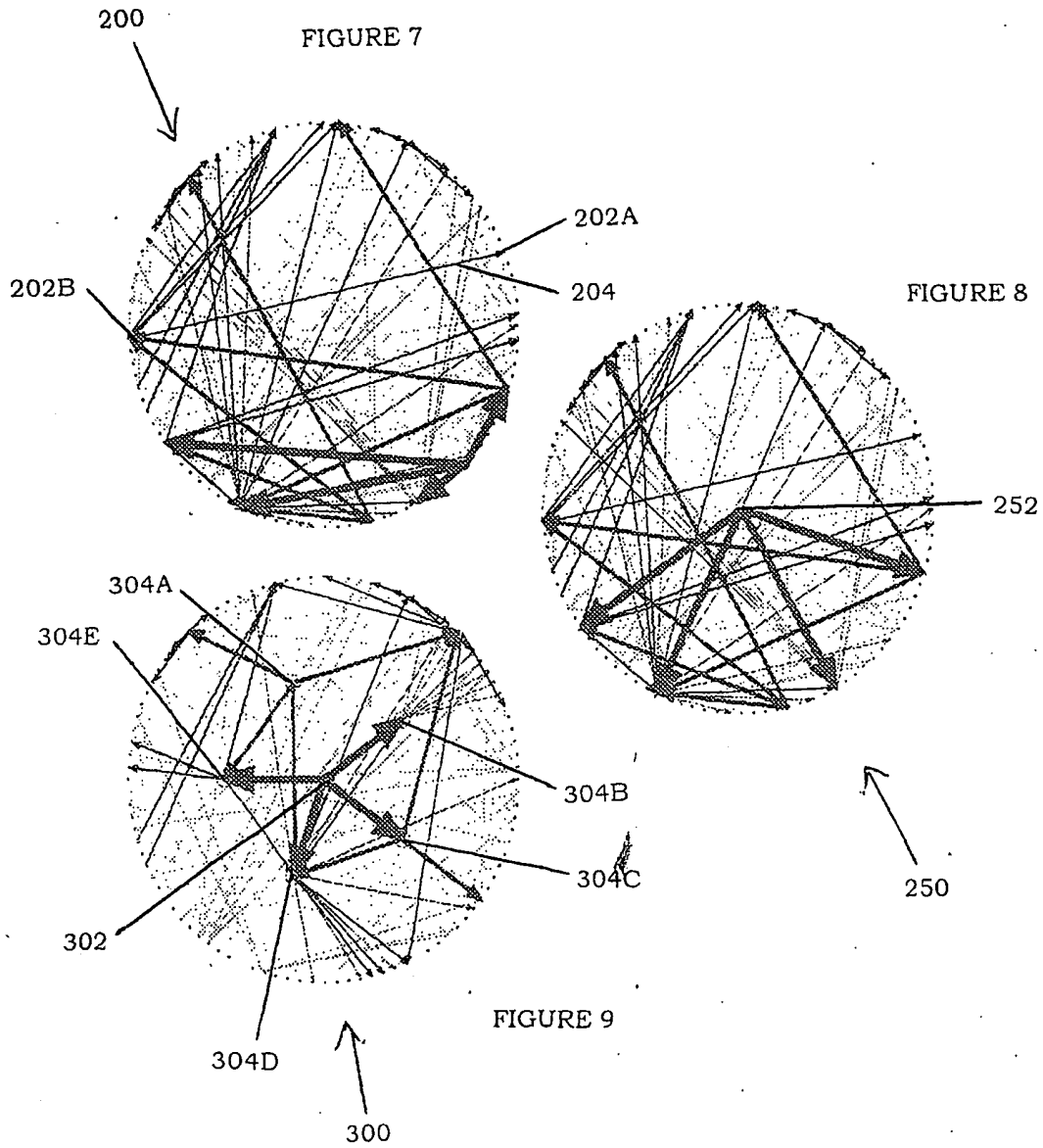
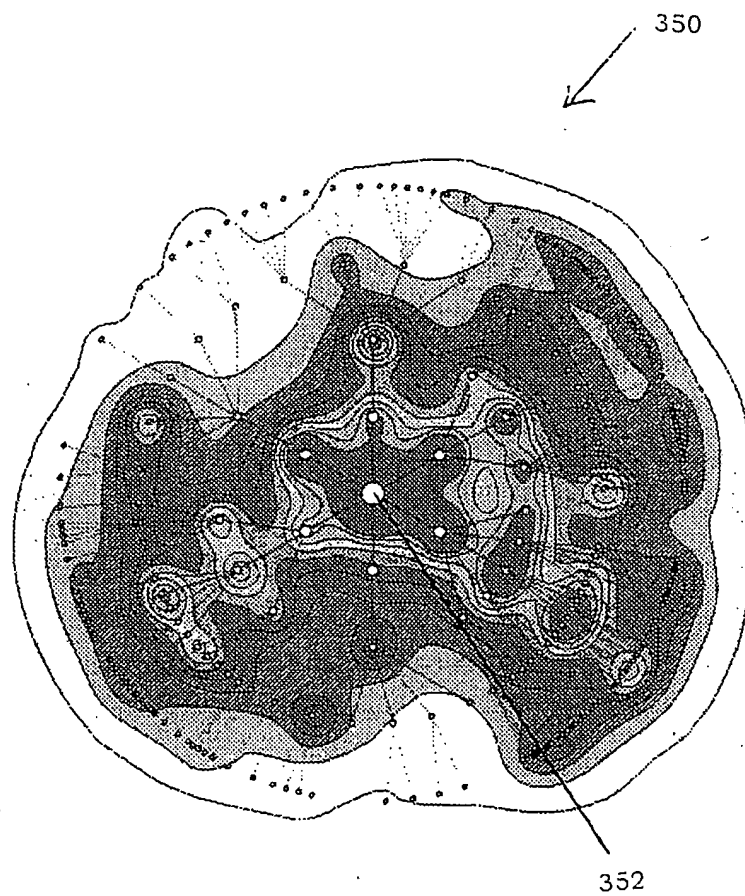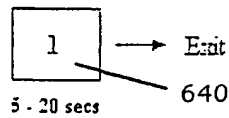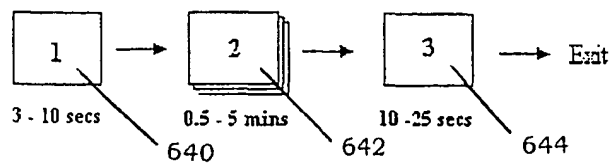FIGURE 10

Site Usage Patterns

Pattern 1 (31% of users)



Pattern 2 (12% of users)



Pattern 3 (7% of users)
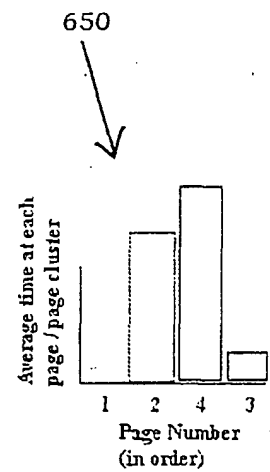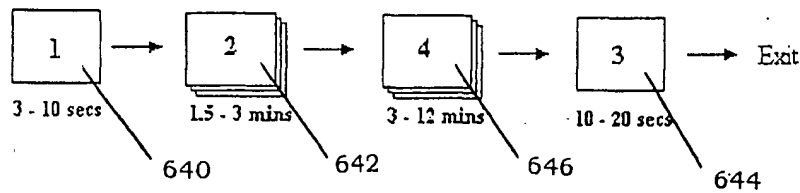


FIGURE 11

(51) International Patent Classification[7]: G06F 17/30

(21) International Application Number: PCT/NZ02/00021

(22) International Filing Date: 26 February 2002 (26.02.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
510178      26 February 2001 (26.02.2001)    NZ

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(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— with international search report

[Continued on next page]

(54) Title: DATA VISUALISATION SYSTEM AND METHOD
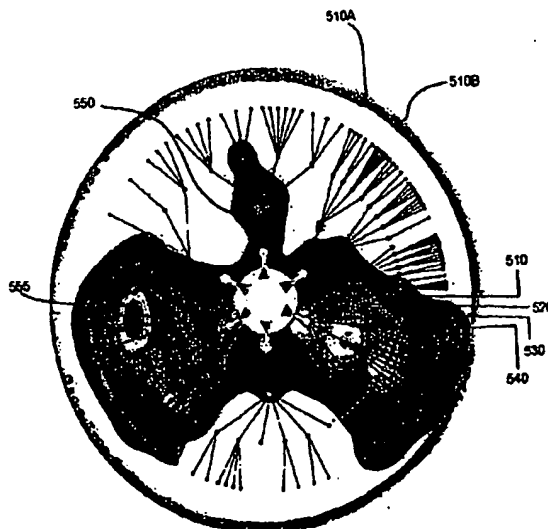
(57) Abstract: The invention provides a data visualisation system comprising a data memory in which is maintained one or more fact data sets comprising an identifier and one or more attributes and one or more finite element data sets wherein the members of each finite element data set define the range of possible values for at least one attribute of at least one fact data set; a retrieval component arranged to retrieve one or more data sets from the memory; and a display component arranged to display a graphical representation of a chosen subset of the set of all fact data sets in the memory as a series of data values. The invention also provides a related method and computer program.

## DATA VISUALISATION SYSTEM AND METHOD

## FIELD OF INVENTION

The invention relates to a data visualisation system and method, particularly but not solely designed to graphically describe or represent information contained within a data warehouse in a user friendly way.

## BACKGROUND TO INVENTION

The low cost of data storage hardware has led to the collection of large volumes of data. Merchants, for example, generate and collect large volumes of data during the course of their business. To compete effectively, it is necessary for a merchant to be able to identify and use information hidden in the collected data. Typically merchants and other companies collect trading and other data and store this data in a data warehouse.

Some software products exist which are intended to allow merchants to see visual reports of data stored in such data warehouses. However, the visualisations produced by such reporting tools are often confusing and difficult to follow.

It would be particularly advantageous to provide a system which enables a user to obtain meaningful information from a data warehouse and have presented to a user representations of this data in a more intuitive and user friendly way.

## SUMMARY OF INVENTION

In broad terms in one form the invention provides a data visualisation system comprising a data memory in which is maintained one or more fact data sets comprising an identifier and one or more attributes and one or more finite element data sets wherein the members of each finite element data set define the range of possible values for at least one attribute of at least one fact data set; a retrieval component arranged to retrieve one or more data sets from the memory; and a display component arranged to display a graphical

representation of a chosen subset of the set of all fact data sets in the memory as a series of data values.

In broad terms in another form the invention provides a data visualisation computer
5   program comprising a series of fact data sets comprising an identifier and one or more attributes stored in a data memory, and one or more finite element data sets wherein the members of each finite data set defines a range of possible values for at least one attribute of at least one fact data set maintained in a data memory, a retrieval component arranged to retrieve one or more data sets from the memory; and a display component arranged to
10  display a graphical representation of a chosen subset of the set of all fact data sets in the memory as a series of data values.

In broad terms in another form the invention provides a method of data visualisation comprising the steps of maintaining in a data memory one or more fact data sets
15  comprising an identifier and one or more finite element data sets wherein the members of each finite data set defines the range of possible values for at least one attribute of at least one fact data set; retrieving one or more data sets from the memory; and displaying a graphical representation of a chosen subset of the set of all fact data sets in the memory as a series of data values.

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BRIEF DESCRIPTION OF THE FIGURES

Preferred forms of the data visualisation system and method will now be described with
25  reference to the accompanying Figures in which:

Figure 1 shows a block diagram of a system in which one form of the invention may be implemented;

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Figure 2 shows the preferred system architecture of hardware on which a present invention may be implemented;

Figure 3 is a preferred representation generated in accordance with the invention;

Figure 4 is a preferred representation generated in accordance with the invention;

Figure 5 is a preferred representation generated in accordance with the invention including contoured data;

Figure 6 is a further preferred representation generated in accordance with the invention including contoured data; and

Figure 7 is a further preferred representation generated in accordance with the invention.

**DETAILED DESCRIPTION OF PREFERRED FORMS**

The preferred forms of the system, method, and computer program according to the invention will now be described in detail with reference to the accompanying figures by way of example only.

Figure 1 illustrates a block diagram of the preferred system 100 in which the data visualisation sysem, method or computer program of the present invention may be implemented. The system includes one or more clients 120, for example 120A, 120B, 120C, 120D, 120E and 120F, which each may comprise a personal computer or workstation described below or alternatively any computing device. Each client 120 is interfaced to a workstation 130 as shown in Figure 1. Each client 120 could be connected directly to the workstation 130, could be connected through a local area network or LAN, or could be connected through the Internet.

Figure 2 shows the preferred system architecture of hardware on which a present invention may be implemented;

Figure 3 is a preferred representation generated in accordance with the invention;

5

Figure 4 is a preferred representation generated in accordance with the invention;

Figure 5 is a preferred representation generated in accordance with the invention including contoured data;

10

Figure 6 is a further preferred representation generated in accordance with the invention including contoured data; and

Figure 7 is a further preferred representation generated in accordance with the invention.

15

## DETAILED DESCRIPTION OF PREFERRED FORMS

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20    way of example only.

Figure 1 illustrates a block diagram of the preferred system 100 in which the data visualisation sysem, method or computer program of the present invention may be implemented. The system includes one or more clients 120, for example 120A, 120B,

25    120C, 120D, 120E and 120F, which each may comprise a personal computer or workstation described below or alternatively any computing device. Each client 120 is interfaced to a workstation 130 as shown in Figure 1. Each client 120 could be connected directly to the workstation 130, could be connected through a local area network or LAN, or could be connected through the Internet.

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Clients 120A and 120B, for example, are connected to a network 140, such as a local area network or LAN. The network 140 could be connected to a suitable network server 145 and communicate with the workstation 130 as shown. Client 120C is shown connected directly to the workstation 130. Clients 120D, 120E and 120F are shown

5    connected to the workstation 130 through the Internet 150. Client 120D is shown as connected to the Internet 150 with a dial-up or other suitable connection and clients 120E and 120F are shown connected to a network 160 such as a local area network or LAN, the network 160 connected to a suitable network server 165.

10   The preferred system 100 further comprises a data repository 170, for example a data warehouse maintained in a memory. It is envisaged that the data repository may alternatively comprise a single database, a collection of databases, or a data mart. The preferred data repository 170 includes data from a variety of sources, and could include data representing interactions between customers and merchants.

15

Typically, a merchant will operate in a commercial premises or store from which a customer purchases goods or services. As a customer interacts with a merchant, the interaction generates interaction data which is then migrated to the data repository 170. In one preferred form, the workstation 130 operates under the control of appropriate operating

20   and application software having a data memory 131 connected to a server 132. The invention is arranged to retrieve data from the data repository 170, process the data with the server 132 and to display the data on a client workstation 120 as described below.

Figure 2 shows the preferred system architecture of a client 120 or workstation 130. The

25   computer system 200 typically comprises a central processor 202, a main memory 204 for example RAM and an input/output controller 206. The computer system 200 also comprises peripherals such as a keyboard 208, a pointing device 210 for example a mouse, track ball or touch pad, a display or screen device 212, a mass storage memory 214 for example a hard disk, floppy disk or optical disc, and an output device 216 for example a

30   printer. The system 200 could also include a network interface card or controller 218 .

5

and/or a modem 220. The individual components of the system 200 could communicate through a system bus 222, or alternatively could be distributed from each other and interfaced over a network.

5   It is envisaged that the data stored in the data repository 170 could be stored in mass storage 214 of the workstation 130, in a client workstation 120, or on a further data memory interfaced to the workstation 130 and/or client 120.

Data stored in the data repository 170 could constitute a data warehouse. A data warehouse
10  is comprised of one or more databases. The one or more databases comprised of two types of table: FACT tables and DIMENSION tables.

A FACT table is a table on which queries can be performed. These facts could include individual interactions involving various entities such as companies or merchants. A
15  FACT table commonly stores large amounts of information and is essentially comprised of source data columns.

A DIMENSION table is a table which defines meaningful ways of separating data contained within a fact table. These attributes or dimensions could include for example a
20  sector identifier representing the industry in which the entity or company operates, and a location identifier identifying the place of operation.

Figure 3 illustrates one preferred representation generated in accordance with the invention in which the data repository 170 includes a plurality of tables, for example COMPANY
25  DIMENSIONS table 300 and FACT table 310. COMPANY DIMENSIONS table 300 could include a plurality of records, each record representing a company, organisation, merchant or other entity. The company dimensions table could include various fields for example company identifier 302, sector identifier 304 and location identifier 306.

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The FACT table 310 could include a plurality of records, each record representing a different interaction involving a company from the COMPANY DIMENSIONS table 300. The FACT table 310 could include various fields, for example, a trade or interaction identifier 312, a company identifier 314, a sector identifier 316 and a monetary value 318.

A retrieval component, for example, a query processor or search engine could obtain user queries and apply these queries to the data table stored in the data repository 170.

A display component could display to a user a graphical representation of the results of such queries. The display could be a software component arranged to display graphic images to a user or the display could be a hardware component such as a computer screen. The invention provides a place for each value/dimension to be placed within the representation. The graphical representation may represent abstract or physical structures and may be represented in 2, 3 to n dimensional space.

·The graphical representation may comprise a hierarchical layout 330 as shown in Figure 3. The hierarchical layout 330 could include a series of nodes displayed as a connected graph. Each node could represent an individual company or entity, for example 340A and 340B. The position of each node within the representation could be based on the sector 304, the location 306 or some other attribute of the company 302. Companies in the same sector 304 could be grouped together and/or companies in the same location 306 could be grouped together. The hierarchical structure 330 enables separation of data and provides a place or location around which further data could be presented.

Figure 4 shows the hierarchical represenation 330 of figure 3 in more detail. The central node 410 of the representation 330 represents all relevant data from the data warehouse before any dimensions have been applied to it. Dimensions are applied to the data in order to seperate out data of interest. The inner circle of nodes 420A, 420B, 420C, 420D, 420E, and 420F represent the division of data after a first dimension has been applied to the data. For example, if the first dimension applied was "Sector" then node 420A may represent

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Consumer, node 420B may represent Healthcare, node 420C may represent Finance, node 420D may represent Resources, node 420E may represent Media, and 420F may represent Technology.

5     The second, third and fourth circles of nodes may represent the division of data which results from applying successive dimensions to the data. Thus the dimensions allow for the sorting and presentation of the data from the data warehouse. The second circle of nodes could, for example, represent location. The data at each node in the inner circle would then be divided again according to location. For example the data included with node 420F

10    could be further divided into nodes 430A, 430B, and 430C, where 430A represents Australia, 430B represents Canada, and 430C represents the United States.

      In an embodiment such as the one described above, a user may be especially interested in the children of a particular node, for example, 420F in figure 4 which represents the

15    Technology sector. Or a node may have many children making it difficult to see the exact configuration for all such children and grandchildren, as is the case for node 430D in figure 4 for example. In cases like these a user may select a node of interest and the method, system or computer program of the invention may allow the user to view a new hierarchical representation with the selected node at the centre of the configuration and the

20    children and grandchildren of that node arranged around it in a configuration similar to that of the parent graph.

      For a data representation similar to that of the preferred form illustrated in figure 4, there are cases where the dimensions applied to the data could be applied in any order. This is

25    the case in the example described above. The dimension Sector is applied first and the dimension Location is applied next. It would be just as possible to apply the Location dimension first, followed by Sector. The preference of the user in selecting the first dimension to apply will depend on the focus of the user's interest in the data. In a case such as this, the user may wish to view the data both ways. The user may, therefore, select

30    a node in a first representation and dynamically change it's position in the hierarchy, by

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dragging it with a mouse for example, or by changing options on a menu or form. The invention may then redisplay the representation with the nodes arranged according to the newly specified hierarchy of dimensions.

5   However, in a representation similar to that illustrated in figure 4, it is also possible that the successive circles of nodes may have a logical relationship which makes most sense when presented in sequence. For example, the first inner circle could represent country, the second circle could represent state, the third city, and the fourth suburb. In this case the order of the successive layers of nodes could be firm as it is not desirable to alter the order
10  in which the dimensions are applied.

The circular graph generated by one or more of the preferred forms of the invention could also form a spatial substrate on which to superimpose contoured data. For example, once the nodes of the graph are arranged in a pre-defined space within the circular
15  configuration, the nodes could be used as data points about which to contour supplementary data which may be, for example, one of various key performance indicators or KPIs retrieved from the data repository 170, for example, revenue, turnover, sales, gross profit, net profit, gross margin of return on inventory investment, net margin return on inventory investment, return on net assets and/or loyalty sales data. Such contouring is
20  described in our patent specification WO 00/77682 to Compudigm International Limited dated 14 June 2000.

Figure 5 illustrates a graph of the same basic form as the representation illustrated in figure 4. In the example illustrated in figure 5 the data of interest relates to gaming machines
25  located, for example, in casinos, bars and pubs on which players may bet by paying amounts made up of various denominations into one or more slots on the machine. The first dimension which has been applied to the relevent data in this example is "Game Type". The centermost node of data may then be divided into an inner circle of n nodes, for example 510, where n is the number of divisions which result from applying the first
30  dimension. The graph area may be divided accordingly into a series of n segments The

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segments of the representation may be delineated along the circumference of the representation with dividers 510A and/or labels 510B.

In the example illustrated in Figure 5, three further dimensions have been applied to the
5   data represented in figure 5 so there are three further layers to the circular graph. Nodes in the first outer circle, for example 520, could represent different game names. Nodes in the second outer circle, for example 530, could represent different denominations which are payed into the machines. Nodes in the final outer circle, for example 540, could represent. particular slots on the machine which can receive bets from players.

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In this representation an additional data field of interest is modeled around the various nodes in the form of contours, for example 550 and 555. The contours may represent a KPI such as percentage increase in hand pull over a chosen month for the particular machines identified by each node in the graph.

15

The display component could be further arranged to display a circular graph to a user such as that illustrated in Figure 6 at 600. Each data value of interest could be displayed a certain distance from the centre point of the circle. The distance could be based on some measure of importance, for example, if the data value represented a company the measure
20   of importance may be company size or average annual turnover. Important companies could be grouped nearer the centre of the circle, whereas less important companies could be placed at the periphery.The circular graph could again be divided equally between the output values of a given dimension. For example, the graph could be divided into a series of segments according to · the application of a dimension "Sector", each segment in the
25   representation corresponding to a different industry sector in which each company operates. Examples of sectors include Financial 610A, Resources 610B, Media 610C, Technology 610D, Consumer 610E, and Healthcare 610F sectors. Each of these segments could be further divided into sub-segments representing industry sub-sectors. For example, the financial sector could be further divided into banks 620A, insurance 620B,
30   and real estate 620C. Nodes representing companies could be positioned within the

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circular graph, for example as shown at 650A and 650B.  Each company representation could be placed in a segment of the circular graph based on the sector identifier of the company.

5      Once the companies are arranged in a pre-defined space within the circular configuration, their locations could again be used as data points about which to contour various key performance indicators or KPIs for that company retrieved from the data repository 170.

       The circular graph shown at 600 provides two axes of similarity, namely sector and
10     importance.  Patterns are more likely to be meaningful to a user since companies that are close together in the display will be in similar sectors and be of similar importance to the market.  It will be appreciated that the invention could display any dimension of data on any substrate.  Figure 6 merely shows one example.

15     In the previous examples, the invention has divided the circular representations of the data into n equal segments depending on the number of possible values which exist for the first dimension applied to the data. However, the invention also encompasses the production of other representations of data which are variations on the basic system and method illustrated by the above examples. It will be appreciated that other configurations are
20     possible and may be produced by the method, system and computer program of the present invention.

       Figure 7 illustrates a configuration of data nodes 700 according to the invention wherein instead of dividing the representation into equal sized segments based on the number of
25     nodes in the inner circle, the outermost nodes have been evenly spaced around the circumference of the representation.

       The foregoing describes the invention including preferred forms thereof.  Alterations and modifications as will be obvious to those skilled in the art are intended to be incorporated
30     in the scope hereof, as defined by the accompanying claims.

**CLAIMS**

1.    A data visualisation system comprising:

      a data memory in which is maintained one or more fact data sets comprising
an identifier and one or more attributes, and one or more finite element data sets
wherein the members of each finite data set defines the range of possible values for
at least one attribute of at least one fact data set;

      a retrieval component arranged to retrieve one or more data sets from the
memory; and

      a display component arranged to display a graphical representation of a
chosen  subset of the set of all fact data sets in the memory as a series of data
values.


2.  A data visualisation system as claimed in claim 1 wherein the graphical
representation has a substantially circular configuration.


3.  A data visualisation system as claimed in claim 1 or claim 2 wherein the graphical
representation comprises a circular graph.


4.  A data visualisation system as claimed in claim 2 or claim 3, arranged to retrieve
one finite data set and divide the graphical representation into two or more
segments, each segment matching a member of one of the finite element sets and an
attribute of at least one member of the chosen subset of the set of all fact data sets .


5.  A data visualisation system as claimed in claim 4 further arranged to retrieve a
further finite element data set and divide each segment into one or more sub-
segments, each sub-segment matching a member of the further finite data set and an
attribute of at least one of the members of the chosen subset of the set of all fact
data sets included in the segment.

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6. A data visualisation system as claimed in any one of claims 2 to 5 where the chosen subset of the set of all fact data sets is represented by one or more nodes within the representation

5      7. A data visualisation system as claimed in claim 6 wherein the graphical representation is arranged to create a new circle of nodes on the outer circumference of the graph whenever the graph divides, the number of nodes equal to the number of new segments, and each node in the new circle substantially the same distance from the centre of the graph.

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8. A data visualisation system as claimed in claim 6 or claim 7 arranged to superimpose contoured data representations around each node in the representation such that each data point is displayed as a local maximum.

15     9. A data visualisation computer system comprising:

one or more fact data sets comprising an identifier and one or more attributes, and one or more finite element data sets wherein the members of each finite data set defines the range of possible values for at least one attribute of at least one fact data set all data sets maintained in a data memory;

20         a retrieval component arranged to retrieve one or more data sets from the memory; and

a display component arranged to display a graphical representation of a chosen subset of the set of all fact data sets in the memory as a series of data values.

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10. A data visualisation computer program as claimed in claim 9 wherein the graphical representation has a substantially circular configuration.

11. A data visualisation computer program as claimed in claim 9 or claim 10 wherein
30     the graphical representation comprises a circular graph.

12. A data visualisation computer program as claimed in claim 10 or claim 11, arranged to retrieve one finite data set and divide the graphical representation into two or more segments, each segment matching a member of one of the finite element sets and an attribute of at least one member of the chosen subset of the set of all fact data sets .

13. A data visualisation computer program as claimed in claim 12 further arranged to retrieve a further finite element data set and divide each segment into one or more sub-segments, each sub-segment matching a member of the further finite data set and an attribute of at least one of the members of the chosen subset of the set of all fact data sets included in the segment.

14. A data visualisation computer program as claimed in any one of claims 10 to 13 where the chosen subset of the set of all fact data sets is represented by one or more nodes within the representation.

15. A data visualisation computer program as claimed in claim 14 wherein the graphical representation is arranged to create a new circle of nodes on the outer circumference of the graph whenever the graph divides, the number of nodes equal to the number of new segments, and each node in the new circle substantially the same distance from the centre of the graph.

16. A data visualisation computer program as claimed in claim 14 or claim 15 arranged to superimpose contoured data representations around each node in the representation such that each data point is displayed as a local maximum.

14

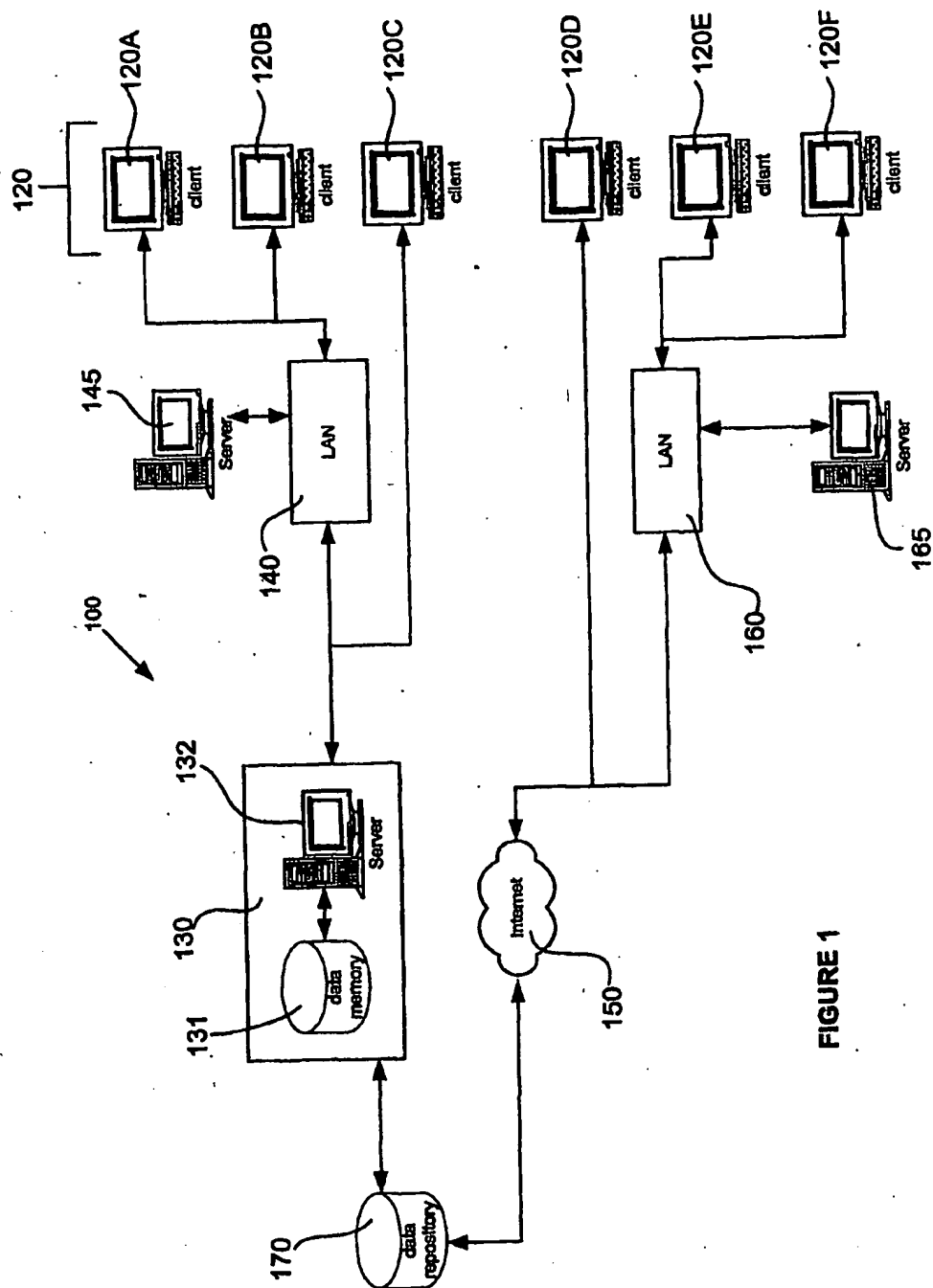17. A method of data visualisation comprising the steps of storing in a data memory one or more fact data sets comprising an identifier and one or more attributes, and one or more finite element data sets wherein the membersof each finite data set defines the range of possible values for at least one attribute of at least one fact data set; retrieving one or more data sets from the memory; and displaying a graphical representation of a chosen subset of the set of all fact data sets in the memory as a series of data values.

18. A method of data visualisation as claimed in claim 17 wherein the graphical representation has a substantially circular configuration.

19. A method of data visualisation as claimed in claim 17 or claim 18, wherein the graphical representation comprises a circular graph.

20. A method of data visualisation as claimed in claim 18 or claim 19 further comprising the steps of retrieving one finite data set; and dividing the graphical representation into two or more segments, each segment matching a member of one of the finite element sets and an attribute of at least one member of the chosen subset of the set of all fact data sets.

21. A method of data visualisation as claimed in claim 20 further comprising the steps of retrieving a further finite element data set; and dividing each segment into one or more sub-segments, each sub-segment matching a member of the further finite data set and an attribute of at least one of the members of the chosen subset of the set of all fact data sets included in the segment.

22. A method of data visualisation as claimed in any one of claims 18 to 21 further comprising the step of representing the chosen subset of the set of all fact data sets as one or more nodes within the representation.

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23. A method of data visualisation as claimed in claim 22 further comprising the step of creating a new circle of nodes on the outer circumference of the graph whenever the graph divides, the number of nodes equal to the number of new segments, and each node in the new circle substantially the same distance from the centre of the graph.

24. A method of data visualisation as claimed in claim 22 or 23 further comprising the steps of superimposing contoured data representations around each node in the representation such that each data point is displayed as a local maximum.
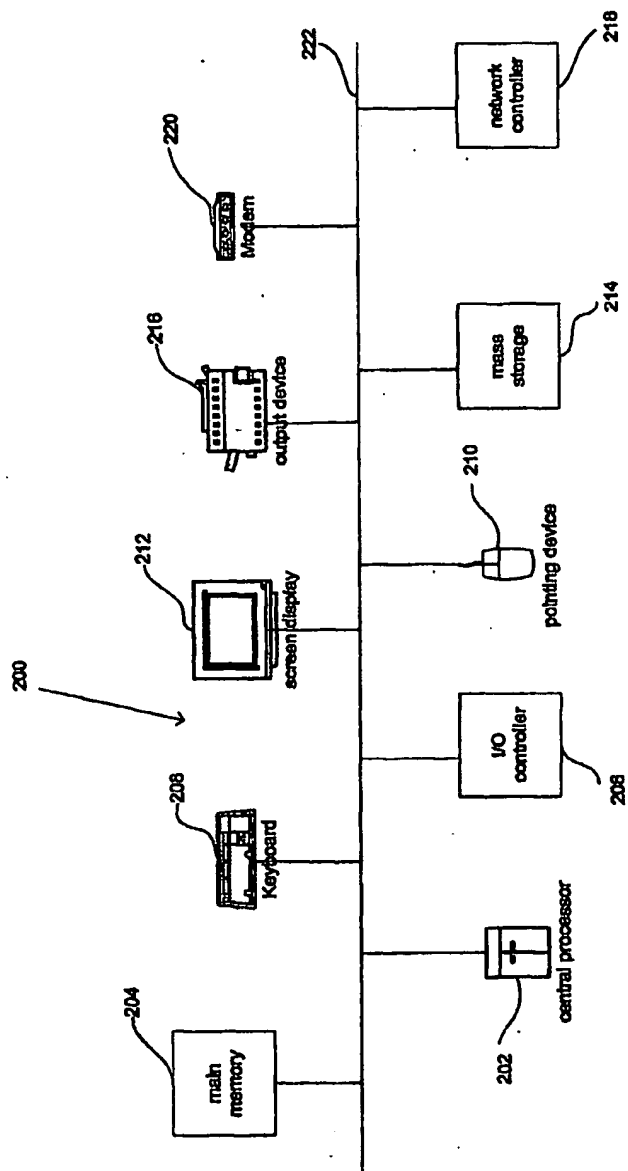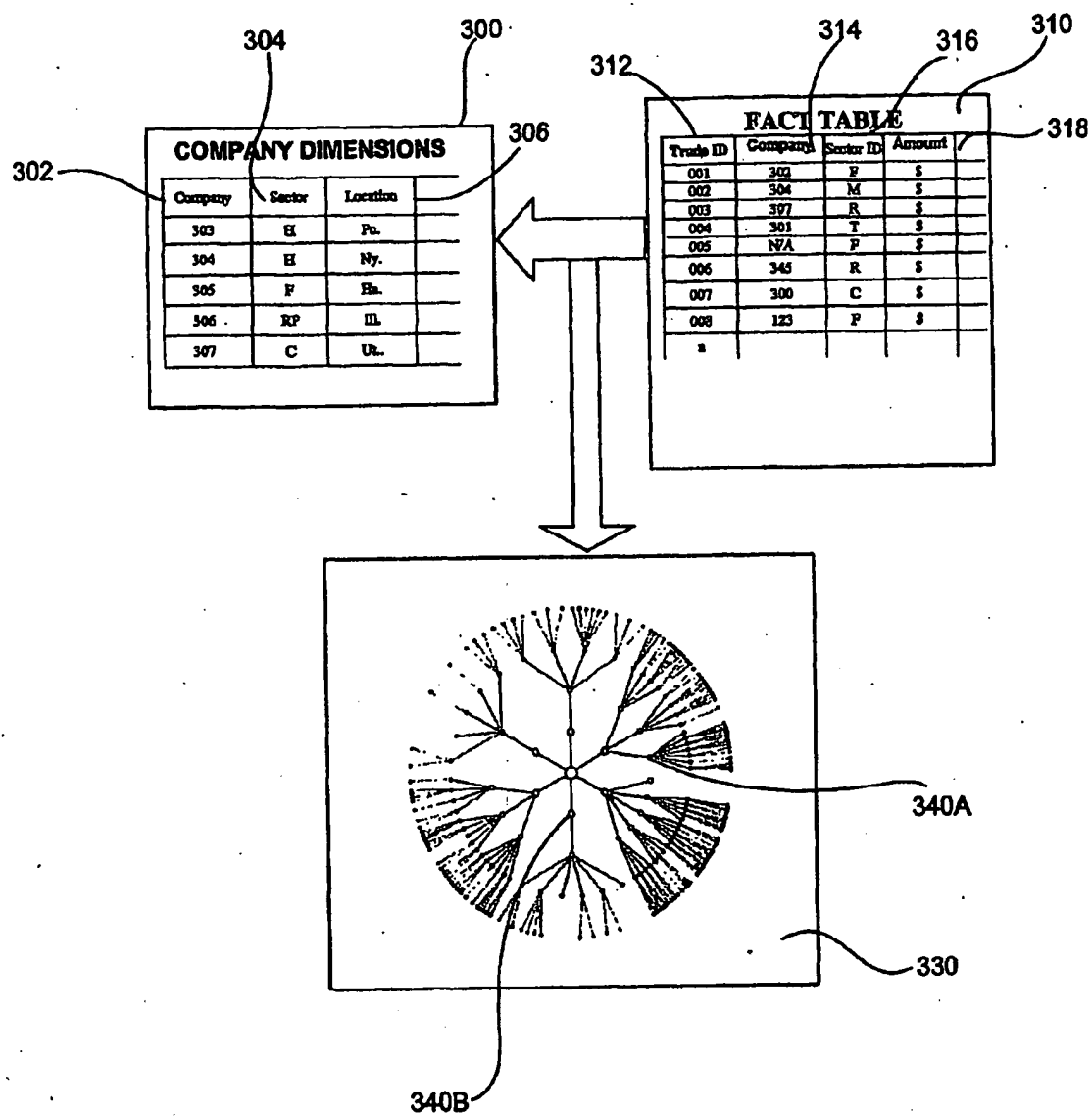
FIGURE 1

FIGURE 2

**COMPANY DIMENSIONS** (300, 304)

| Company | Sector | Location |
|---------|--------|----------|
| 303 | H | Pa. |
| 304 | H | Ny. |
| 305 | F | Ra. |
| 506 | RP | Ill. |
| 307 | C | Ut. |

302, 306

**FACT TABLE** (310, 312, 314, 316, 318)

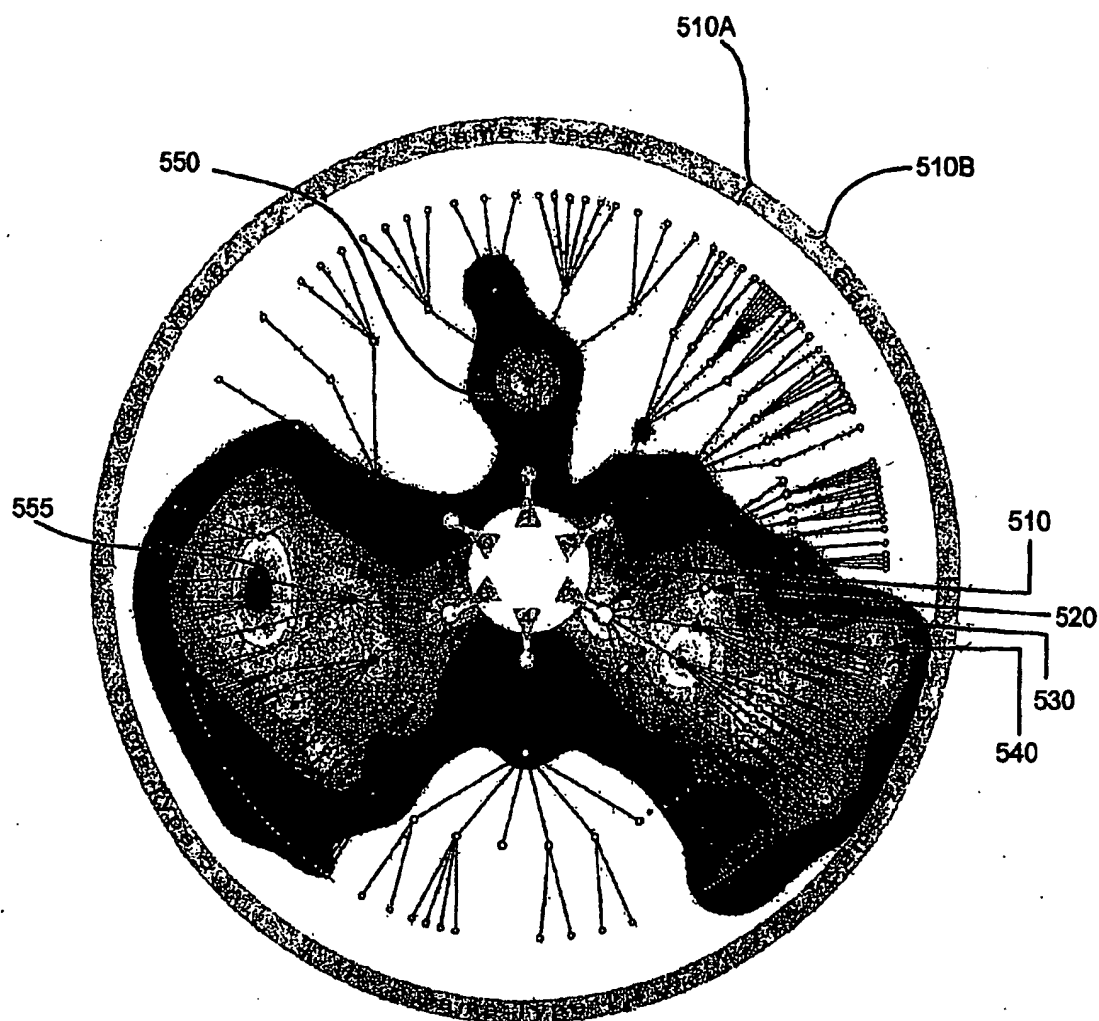| Trade ID | Company | Sector ID | Amount |
|----------|---------|-----------|--------|
| 001 | 302 | F | $ |
| 002 | 304 | M | $ |
| 003 | 397 | R | $ |
| 004 | 301 | T | $ |
| 005 | N/A | F | $ |
| 006 | 345 | R | $ |
| 007 | 300 | C | $ |
| 008 | 123 | P | $ |
| a | | | |

330, 340A, 340B
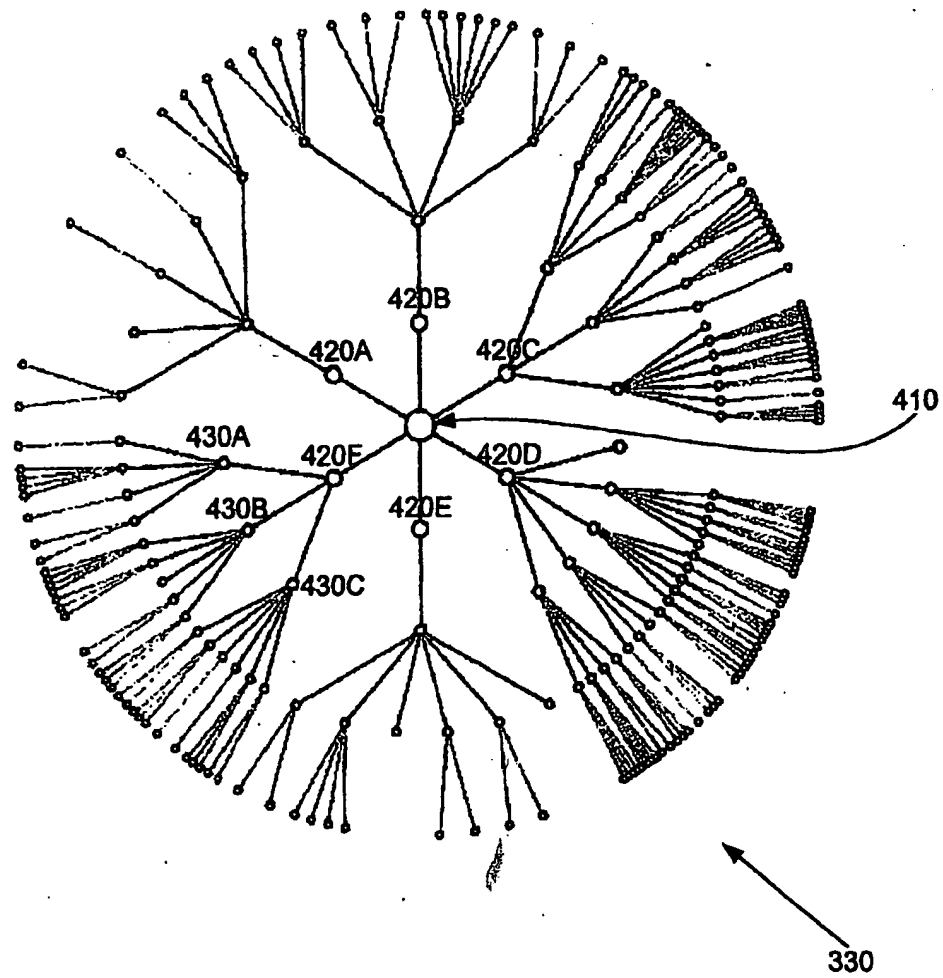
FIGURE 3

FIGURE 4

**FIGURE 5**

FIGURE 6

700

**FIGURE 7**